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PARTIAL HISTORY OF HAYING EQUIPMENT

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Sickles, Scythes, Mowers

Sickles.

It is stated in American Agricultural Implements (1, p. 78, 1/) that "Making hay - cutting and drying grass for fodder - was a familiar duty among ancient stock raisers." It seems probable that the first implement used for cutting grass was the sickle, and that it was followed by the scythe.

While it is impractical, if not impossible, to note every step in the development of this class of agricultural implements from the earliest sickles to the present day tractor power take-off mowing machines, some of the more important ones are mentioned herein. An attempt has been made to list the various steps in chronological order so far as possible, although writers on this subject do not always agree as to the exact date or importance of certain inventions or improvements.

It is stated in (2, p. 8) that "These ancient Egyptian sickles varied somewhat in form and material. The earliest form consisted of a slightly curved blade fastened at one end to a straight handle ***** both iron and bronze being used. Later the toothed sickle appeared, ***** the form approaching more nearly that of the modern sickle. The ancient Chinese and Japanese used an implement resembling the sickle, and almost the same thing is used by them today." (1902) (2, p. 8)

"The implements of the Jewish people resembled closely those of the Egyptians. The sickle was very common. ***** To Greece the art of agriculture was passed down from the Egyptians. The Romans, too, aided in the development, and considerable advancement was made in the form of implements during Greek and Roman times. ***** Among Roman implements we find besides the ordinary form of sickle and reaping hook a small hooked knife resembling a pruning knife, which was used for reaping. It is at this time also that we find the first records of the scythe being used, and although it is not known exactly when it first appeared, the Romans certainly used it, as ancient Roman drawings show. It was crude in form, consisting of a heavy blade on a long straight handle, and was used more for grass than for grain, the sickle remaining preeminently the reaping implement. Pliny distinguished between the sickle and the scythe, although both were at that time called 'sickles.' The shorter one, which resembled the modern form, he termed the Italian sickle, and the longer one, with two handles or hand holds, which corresponded to our present scythe, he called the Gallic sickle." (2, p. 8-9)

"After Roman times agriculture began to decline and continued at a very low state ***** almost throughout the Middle Ages. ***** After about ten centuries agriculture began to revive, and with it was brought back the extensive use of the sickle and scythe. Crescenzo in 1548 gives an account of the implements then in use, and among them we find forms of the sickle and scythe as shown by drawings. From this time on, both are found in very general use throughout different countries, and both have remained as useful implements up to the present time" (1902). (2, p. 9)

1/Figures in parenthesis refer to list of citations at end of each section.

Note: The mention of manufacturers of haying equipment implies no particular endorsement thereof by the Department of Agriculture.

"As already stated, the early Egyptian sickle consisted of a slightly curved blade of iron or bronze, attached to a straight handle, while the toothed form of the implement was a later Egyptian type. Soon a greater bow was given the blade and it began to look more like the modern form. The smooth sickles were heavier than the serrated forms, and were generally used for cutting near the ground with a chopping motion. The toothed sickle was used to cut the grain nearer the top by means of a drawing motion. As time went on the blade was strengthened by an iron ridge near the back, and finally a steel edge was used. With these improvements both the smooth and serrated sickles reached their most perfect form." (2, p. 9-10)

From the foregoing it will be seen that centuries ago the cutting of grain and grass was done with implements or tools similar to those that are still used in many places in the world today.

Scythes.

"Far back in the history of art 'Time' himself is represented as a winged old man with a primitive scythe in his hand. ***** The scythe of the present day (1892) is of Anglo-Saxon origin, and was first spelled 'sithe.' In ancient days a scythe was affixed to the axles of war chariots, intended, like that held by 'Time' to mow down men instead of grain. With the advancement of civilization however, this useful apparatus became associated solely with the peaceful implements of agriculture." (3, p. 12)

"The scythe was a later implement than the sickle, and was an evolution from it. It forms what might be termed the second class of reaping appliances, the sickle being first. ***** This second class made its appearance about the time of the Roman era. The first forms had straight handles, and were very clumsy and heavy, being used only for cutting grass. A Flemish implement known as the Hainault scythe was a form intermediate between the sickle and scythe, and was used for cutting grain. It consisted of a wide blade about two feet in length, with a handle a little over half as long. It was held in the right hand with the forefinger in a leather loop, the blade being kept in a horizontal position by a flat, projecting part of the handle against the wrist. ***** The grain was gathered by a hook held in the left hand. This was much more efficient than the sickle." (2, p. 10)

"The scythe of the pre-historic Lacustrine inhabitant of Switzerland was curved, and was attached to a handle, forming an implement substantially the same as we now (1894) use, and that likewise when swung into the grass or grain, described the segment of a circle in cutting, and so does the sickle. It was this natural, primitive movement that the first constructors of both reapers and mowers tried to imitate or reproduce in their machines, and early American inventors of mowers persistently endeavored to make practically operative this original principle. Indeed, it was many years before the rotary or scythe-curve theory of cutting was abandoned." (1, p. 78)

That the mowing machine after its invention did not immediately supplant the scythe as a grass cutter is indicated in a statement in a U. S. census publication issued in 1860: "Tedious and laborious as its use appears, compared with that of the mowing machine, it is wonderfully effective in comparison with the crude practice of the Mexican of our day who cut his grain and hay by handfuls with a common knife." (4, p. xxiii)

It seems probable that the early settlers in the United States brought with them at least some of the tools and implements which they were accustomed to use, including the scythe. However, "It may not be generally known that the most valuable improvement made upon this implement for centuries was by one of the first iron-workers of Massachusetts, more than two hundred years ago in the very infancy of the colony. In the year 1646 the general assembly of that province granted to Joseph Jenckes, of Lynn, a native of Hammersmith, in England, and connected with the first iron-works in that colony, the exclusive privilege for fourteen years 'to make experience of his abillities and inventions for making,' among other things, of 'mills for the making of sithes and other edge-tooles.' His patent 'for ye more speedy cutting of grasse' was renewed for seven years in May, 1655. The improvement consisted in making the blade longer and thinner, and in strengthening it at the same time, by welding a square bar of iron to the back, as in the modern scythe, thus materially improving upon the old English scythe then in use, which was short, thick and heavy, like a bush-scythe." (4, p. xxiii.)

In the Report of the Commissioner of Agriculture for 1869, p. 451, an odd method of cutting grass is reported as follows:- "A correspondent writing from Marion County, Florida, says 'They mow grass here with a hoe. It's a fact. A well known physician told me the other day that he believed there was not a scythe in the city except mine. Those who don't mow with the hoe do so with the reaping hook.'" (5, p. 451)

Mowers

The early history of mowers and reapers is very closely interwoven, it having been the aim of early inventors apparently to build a machine that would work equally well in mowing grass or cutting grain. "The mower was at first simply the reaper dismantled of its platform, and other parts not needed for grass cutting, although separate machines for this purpose were early constructed. As the mower required a higher speed of the knives than the reaper, no successful type of this machine was constructed until a device for accomplishing this end was invented." (2, p. 28)

Ardrey (p. 79) states that "As reapers and mowers belong to the same original general class, 'harvesters' and have, as was particularly the case at first so many features in common, it is somewhat difficult at times to draw the line between them. In many of the older patents they are described as machines for reaping and mowing, having been designed for both purposes, and in some specifications they are described first as one and then as the other without distinction of purpose, so one cannot always clearly understand to which division of the general class the inventor intended his machine, or to which it really belonged. (1, p. 79)

For example, Carl R. Woodward (6, p. 14) in writing of the early cutting machines makes the following statement:- "The first American patent for a mowing machine of which we have record was taken out May 17, 1803, by two Jersey-men, Richard French and J. T. Hawkins. Very little information concerning this machine has been preserved. From the meager data available, we learn that the reaper was supported on three wheels, one wheel extending into the grain. The horses drew in front on one side, opposite the cutters, which were a series of scythe knives revolving on a vertical spindle." (6, p. 14) The description

that follows the above quotation seems to apply to a grain harvesting machine rather than to a grass cutter, although in the first sentence of this quotation it is definitely called a "mowing" machine.

In (7, p. 212) it is stated that "The invention of American horsepower mowing and reaping machines dates from patents issued as early as 1803, but not until a generation had passed were any effective devices introduced, and before 1840 their use was so limited as to have no effect on harvesting costs or crop acreage. A few mowing machines were in use on river flats in Herkimer County, New York, about 1840. IN New England they were not in use until after 1850." The authors of the foregoing quotation omitted the name of the inventor, and the exact date of the patent, but it is quite possible they referred to the French and Hawkins machine above mentioned.

"In 1811 a Mr. Smith, of Deanston (probably England) built a machine ***** which he kept improving until 1814, when it performed its work better than any which had appeared up to that time. It was designed primarily as a mowing machine. It had the rotating-cutter principle, and consisted of a framework mounted upon two wheels, bearing an inverted conical drum with a projecting circular knife at its lower and smaller end. This drum was made to revolve by motion transmitted to it by a system of cogs connected with the wheels, thus severing the grain and bearing it to one side into a swath. Two small wheels beneath the drum kept the knife at a proper distance from the ground, and a contrivance was added by which this distance could be increased or decreased. It followed the old plan of having the horses hitched behind the machine." (2, p. 14)

Miller (2, p. 39) is authority for the statement that "The idea of a separate machine for cutting grass was conceived in America, the first attempt to construct such a machine being by Peter Gaillard, of Pennsylvania, whose patent was dated December 4, 1812. The machine was not successful, however, and it is remarkable only as being the first." (2, p. 39)

Ardrey states that previous to this date (December 4, 1812) "several crude reaping machines had been produced in England, but none of them had passed the experimental stage or been put up in practical form, and all were intended as their construction and descriptions indicate, for cutting grain and not grass. The credit for the conception, therefore, of mowing grass with a machine propelled by other than man power belongs to an American inventor, although because reapers and mowers are usually classified together, writers on this subject speak of these old English reapers as mowing and reaping machines." (1, p. 78)

Under date of February 13, 1822, Jeremiah Bailey, of Chester County, Pennsylvania, obtained a patent for a grass-cutting machine or mower, which is said to have "made considerable stir at the time, in England as well as in this country." Ardrey quotes the Mechanic's Magazine (British) 1823 as follows:- "The mowing machine of which the above cut is a representation was invented by Jeremiah Bailey, of Chester County, United States, who has obtained a patent for the same. It has been extensively used and approved of during the last season in the neighborhood of the patentee, and promises to be of great public utility. It is understood that it will mow ten acres per day. The following description will explain its operation and show the skill and ingenuity of the inventor: 'This machine is supported by two wheels on different axles. The left wheel is fixed to its axle, so that they revolve together. The right revolves on its axle like a

common cart wheel, and is placed about a foot further back than the other. The left works within the frame, and has a circle of cogs screwed on the outside of the felloes, but of a less diameter, to keep them from the ground. These cogs work into a vertical cog wheel in front that turns an iron shaft extending horizontally toward the center of the machine; upon the inner end of this shaft is fixed a vertical face wheel, whose cogs turn a trundle-head on a vertical shaft. To the bottom of this shaft, near the ground, is fixed a circular horizontal framework, on the circumference of which is screwed the scythes in six parts, laid horizontally, with the edges turned outward, so as to form a complete circle. To keep the scythes at a proper distance from the ground the bottom of the shaft is supported on a piece of wood of the machine, secured by a tie from the tail, somewhat resembling a sled runner, in which it works in the manner of a gudgeon; with the inequalities of the ground the scythe frame shaft and trundle-head rise and fall. The edge of the scythe, in its revolution, passes under a whetstone fixed on an axis, and revolving with the scythe. To create friction this axis is more or less inclined to the line of the direction of the revolution, according to the friction required. This tone, by means of a sliding rod by which it is attached to the machine, rises and falls with the scythes. ***** The horse is put into shafts and walks in front of the left side of the machine, and always on the mowed ground after the first swath is cut. ***** The grass as it is cut is first thrown by the progressive motion against a rise in the scythe frame toward the center, and by the same motion is afterward thrown off in a regular row, following the center of the machine.'" (1, p. 78-79)

"The next patent was granted July 3, 1824, to John A. Wadsworth, Portsmouth, Rhode Island, for a horse scythe. May 18, 1825, E. Cope and J. Hoopes, Jr., of Chester County, Pennsylvania, received a patent on a mowing machine somewhat similar in principle to that of Jeremiah Bailey, described, but of better form and simpler construction. A letter written in 1854, by N. Cope, son of E. Cope, contained the following regarding this mower:- 'This was a very efficient machine but was chiefly used for mowing grass, and it would cut an acre in thirty minutes by the watch, better than it possibly could be done by hand.'" (1, p. 79)

Erastus Ingersoll on May 7, 1830, patented a machine which was clearly "intended for cutting grass." Ardrey describes it as follows:- "Runners bearing some resemblance to those of a sleigh are framed together. A roller-extending across from one of these to the other at the back part rests upon the ground, and revolves when the machine is drawn forward. Two pieces serving as shafts extend forward, being secured by proper framing. The mowing or cutting part is a horizontal wheel about eight feet in diameter, running near to the ground, its lower gudgeon fitted in a piece framed across the runners, and its upper is one of the shaft pieces. A band from the roller extends to a wheel on the axis of this cutting wheel to give it motion. The cutters are knives fitted on to the periphery of the wheel so as to form a complete circle." (1, p. 80)

"Although the next patent, to William Manning, Plainfield, New Jersey, May 3, 1831, covered wheat was designated a reaping machine, its cutting device marked an important step in the development of mowers. Quoting from the description: 'From the axletree extend two arms. ***** The two arms are united together by a cross-bar at their extreme ends, which cross-bar when the machine is in action rests and slides forward on the ground. Teeth of six or eight inches in length, more or less, are set like rake teeth, standing forward on the cross-bar. These are made slender, and are for the purpose of holding the grass or

grain to be cut. ***** A flat bar of iron lies along upon the cross-bar and the cutters are to be attached to this upper bar. The cutters are spear-shaped, and are sharpened on each of their edges. They may vary in their length and width, but ordinarily they may be about six inches long, and three or four wide at their bases. The grass or grain, which is held up by the teeth, passes between these knives or cutters." (1, p. 80)

Two patents covering mowing machines were issued in 1833, the first of which was dated April 26, and was granted to Richard Heath, West Newbury, Massachusetts. This machine is said to have been "similar in principle to the Bailey." The other 1833 patent was granted on June 29, to Thomas A. Anderson, of McMinn County, Tennessee. "Both these machines drove revolving scythes placed near the ground, and neither contained anything specially new and valuable in the art." (1, p. 80)

While the invention patented by Obed Hussey on December 31, 1833, is probably more often considered a grain harvesting machine than a grass cutter, still, according to Miller, "Hussey's combination of the reciprocating knife and slotted guards is used with some improvements upon all mowers of the present day." (1902) "Hussey brought out the principle; others helped to perfect it. The history of the mower from 1833 to the present day" (1902) "has been simply a perfecting of this type of cutter bar, and the working out of certain necessary details." (2, p. 39)

"In this development there were two classes of machines; (1) Those having a rigid bar and single drive wheel, and later (2) those having the double drive wheel and flexible bar. In the first type there was sometimes a smaller wheel to support the cutter bar, and sometimes none: while in the latter the cutter bar was jointed to the machine, and had, if any, only a small roller at the end." (2, p. 39-40)

"December 23, 1834, Enoch Ambler, Root, New York, obtained a patent for a machine to cut grain by horse power. There seems to be much difference of opinion as to the merits of Ambler's invention. ***** But an examination of the cut of his old finger-bar will show that for one of the earliest efforts it was a long step in the direction of successful grain cutting by horse power." (1, p. 81) It will be observed that the authority just quoted very definitely calls the machine in question "a machine to cut grain by horse power."

Abraham Rundell, of New York, was granted a patent on April 22, 1835, which "covered a new idea in cutting. The device consisted of two sickles or cutters, with corresponding points, to be operated in contrary directions, thus making a double shear cut with each pair of points, the whole operating like a series of double-acting scissors. This was the first of a number of inventions and improvements upon the same principle made both in this country and in England; and the cutting device of one of the most successful mowers of its time, the Danford, was of this character." (1, p. 81)

An inventor who seems to have realized "the importance of adjustability or flexibility in a cutting apparatus" was Alexander M. Wilson, of New York, who on September 3, 1846, "received a patent on a mower, with a cutting wheel something like that of the Bailey. ***** He originally took out a patent on the same machine substantially, in 1835, and the model and records having been burned by the great fire in the patent office, 1836, he was allowed to renew his patent in 1837,

but in doing so he made more prominent the adjustable or flexible feature, which as slightly improved, in his patent of 1846, was covered by claim as follows: 'I claim jointing the horse-frame to the forward part of the main frame, but back of the shaft of the cutting wheel, so as to have the horses forward and to the side of the cutter, in combination with a wheel of cutters for cutting grain or grass, so that the cutters may follow the undulations of the ground, independent of and not affected by, the up-and-down movement of the horses, as here-in described.'" (1, p. 87)

"A name that stands out prominently in the development of mowers is that of William F. Ketchum, who has sometimes been spoken of as the father of the mower trade, since he was the first to put mowers on the market as a type of machine distinct from the reaper. He took out several patents, but the one granted July 10, 1847, was of especial importance. The main features of this patent were the unobstructed space left between the driving wheel and the finger bar, with its support, and the remarkable simplicity of the machine. The cutter was an endless chain of knives, which never became successful, but which caused some excitement at the time. Ketchum afterward adopted the Hussey type of cutter, and produced a very successful mower of the rigid-bar type. It was this machine that led the way in mower development and became the first really practical machine." (8, p. 163)

The authors of the foregoing quotation referring to the Hussey invention make the following statement:- "Hussey's first machine was really a mower, and it was upon this principle that the mower was afterward built. Many of the early machines contained combinations of the mower and the reaper, and were used with a little adjustment to cut either grain or grass." (8, p. 162-163)

Another early inventor of a mowing machine, who is perhaps better remembered by reason of having been "the first of record to attempt to bind grain by machinery," was John E. Heath, of Warren, Ohio, who "Somewhere about 1840 ***** took first premium for his mower at the State Fair in Chicago, and in 1855 he was awarded the \$1,000 grand gold medal offered by the Massachusetts Agricultural Society for the best mowing machine." (1, p. 65)

According to Miller "A. J. Purviance, of Ohio, May 22, 1849, obtained a patent for constructing the platform separate from the other framework so as to convert the machine into a mower or reaper as required. This was the first practical combined machine, and marked the beginning of the long list of such machines both in America and England." (2, p. 30)

A patent was issued to Eliakim B. Forbush, under date of November 17, 1849. "His claim in this, his first patent, is on an open triangular tooth, or triangular hollow tooth for cutting grass and grain, 'the object being to diminish friction in vibration and to afford a more perfect clearance.'" Another patent was issued to this inventor on July 20, 1852. This latter patent embraced "four claims relating to guard fingers, etc., also to a pivoted raking arrangement. This patent was afterwards assigned to Cyrenus Wheeler, Jr., and re-issued in several divisions, mainly to cover points pertaining to reaping machines. The Forbush machines were made in Buffalo, New York, and were put out both as combined and as mowers simply. The machine was quite similar to the Ketchum." (1, p. 82)

A patent was granted to Ebenezer Danford on September 17, 1850, which claimed "The application to a reaping and mowing machine of two sickles working together in opposite directions ***** so as to throw the weight of the moving part upon opposite sides of the center of the crank or bit, for the purpose set forth." Mr. Danford's machine did not make much of a record as a reaper, but as a mower it was quite noted for its excellent cutting qualities, though the time and care required to keep the sickles in good working order proved a bar against its entrance into general favor. A considerable number of them were made, sold and satisfactorily used." (1, p. 84)

One of the very popular combined reapers and mowers was that of John H. Manny, whose "first patent was granted September 23, 1851, and covered his triangular frame, which was one of the principal features of his machine as a reaper. November 23, 1852, he obtained another patent, covering the combination of a 'tract scraper' with drive wheels; and also the form and construction of guard fingers so as to cut well and avoid clogging. This and other patents were re-issued largely (as usually were important patents during those early years) but they related to details of construction rather than to new principles." (1, p. 84)

A number of patents were issued during the fifties, but space does not permit describing each in detail. Among the number, however, may be mentioned the one granted July 20, 1852, "to Jesse S. and David Lake, of New Jersey, and the other to Eliakim B. Forbush, Buffalo, New York. The first was afterwards assigned and re-issued to James A. Saxton, Canton, Ohio. It had a single driving wheel, but it claimed the attachment, by double hinged arrangement to the frame of any mowing machine, of the cutter bar, 'so that the guards or fingers, or that part to which they are sustained and supported, will be free to rise or fall bodily, and also to have a lateral or wabbling motion to enable the cutting apparatus to conform freely to the undulations of the ground over which it is drawn, independent of the up-and-down motion of the main frame.' It also claimed lever, coupling piece, etc." (1, p. 87-90)

"The Forbush patent assigned and re-issued to Cyrenus Wheeler, Jr., as to mowers, covered the 'making of the outer and inner shoes broader in front of the finger-bar,' and 'the bearing piece ***** placed between the outer shoe and guard finger, for the support of the outer end of the cutter bar.'" (1, p. 90)

"Byron Densmore, of New York, February 10" (1852) "obtained a patent which as afterwards re-issued and assigned to D. M. Osborne and W. A. Kirby had a claim as follows: 'Hanging the driving wheel in a supplementary frame, or its equivalent, which is hinged at one end to the main frame while its opposite end may be adjusted and secured at various heights, or be left free as desired, whereby the cutting apparatus may be held at any desired height for reaping or be left free to accommodate itself to the undulations of the ground for mowing, etc.' The patent became one of the Kirby system controlled by D. M. Osborne & Co. His machine had a single driving wheel, but the cutting apparatus was sufficiently flexible to render it in this respect the only single wheel mower that could compete successfully with the two-wheeled jointed-bar machines." (1, p. 87)

"R. T. Osgood, Orland, Maine, February 17, 1852, got a patent, which, as re-issued and assigned to Cyrenus Wheeler, Jr. covered two independent driving

and supporting wheels on a common axle with a ratchet wheel and pawl for each, so that either could hold in gear when advanced, or be out of gear when backed, a peculiarly hinged arrangement for cutter bar and frame, a lever so that driver could raise or depress cutters from his seat while machine was in motion, a balance wheel 'to equalize the motion of the cutters,' and other points not necessary to mention." (1, p. 87)

A patent of importance in mower construction "was granted to Philo Sylla and Augustus Adams, Elgin, Illinois, September 20, 1853, for a harvesting machine." This patent was sold, and re-issued to the purchaser "in six divisions, five of which related to flexible or hinged-bar devices for mowers." (1, p. 90)

Among the patentees of devices for mowing machines in the fifties may be mentioned George Esterly, who on June 27, 1854, "patented a track clearer of plow shape" and Abner Whitely, whose patent for "the rolling cone for the same purpose," was granted August 22, 1854. (1, p. 91)

"The patent granted to Cyrenus Wheeler, Jr., December 5, 1854, set a stake by the way or marked the division line between the old and the new system of grass cutting, not so much because of the importance or novelty of the features presented as in the fact that it covered a machine that was distinctively in construction and intention a two-wheeled jointed-bar mower, and although its original cutters were discarded it stands in proper form at the head of its class - indicating specific purpose, and combining with the new, valuable old features that were but incidental to and scattered among the inventions previously noticed. ***** Mr. Wheeler seems also to have had a clearly defined purpose, viz., to develop a practical marketable mower upon the new plan. ***** This first Wheeler patent formed the foundation of the 'Cayuga Chief' system, and was as re-issued the first of the long line of patents which several years after were pooled and owned jointly by the leaders in the manufacture of Buckeye, Ball and Cayuga Chief machines, when they made their great combination. ***** Mr. Wheeler took out many patents - covering points relating to mowers in general, and devices pertaining specially to the Cayuga Chief, either as reaper or mower, which by the way, was a rear-cut machine, i. e., the cutter-bar was rearward of the driving wheels." (1, p. 90-91)

"Apparently the first conception of flexibility or automatic adjustability to the ground surface in the cutting apparatus was shown in the mower of Jeremiah Bailey, 1822," according to Ardrey, who also states that "Hussey's machine of 1833 had its draft attachment in front of two driving wheels; and the frame behind, which bore the laterally projecting finger bar, having been hinged to the main axle and supported in the rear by a little wheel, could to a certain extent accommodate itself and the cutting apparatus, in the forward movement, to the inequalities of the ground uncontrolled by the passage over of the driving wheels. This was the beginning of practical flexibility." (1, p. 86)

"The next machine in order that showed the features which we are tracing was never patented, but became somewhat famous for reference in after years." In explanation of the preceding statement Ardrey quotes from Knight's Mechanical Dictionary as follows:- 'Hazard Knowles, the machinist of the Washington Patent Office invented in 1837, a reaping machine having a scalloped, reciprocating cutter, the cutting apparatus jointed to a double arm, the opposite end of which was in turn jointed to the main frame, coincident with the axis of the crank-

shaft; both supporting wheels were drivers for the cutters. It was a front-cut machine, and had a lever to raise the cutter bar to clear stumps and other obstructions. A machine was constructed in 1838, and in 1839 was purchased by Joel Lupton, who rode upon the machine along the turnpike to his home, near Winchester, Virginia. The machine was used occasionally during a few of the following years, but was soon laid aside, owing to a fear of the neighbors that it would disturb the relations of labor.'" (1, p. 86)

"It is said that Frederick Nishwitz, of Brooklyn, New York, who took out several patents in this line during the 'fifties, had invented a jointed bar mower many years before" but did not obtain a patent on it. (1, p. 87)

"By 1855 one-wheeled rigid-bar mowing machines had become practical, either in connection with reapers or as mowers alone. Concerning some features it is impossible to determine definitely who presented them first, and others shade from one into another so finely that it is difficult to distinguish them." (1, p. 84)

"In 1855 a patent was granted to Jonathan Haines, which was very important in the development of the flexible cutter bar. It had two drive wheels and a cutter-bar jointed to the main frame in such a manner that it could be lifted over obstructions, and the tongue was rigidly fastened to the main frame." (2, p. 41-42)

Another patent for a track clearing device was granted to "Walter A. Wood, March 20, 1855." This patent covered "the outer wheel with its inner face conical" for the purpose specified. "In those days" (the fifties) "Moses G. Hubbard, then of New York, was an active inventor. June 4, 1855, he claimed 'the employment of the fingers to each sickle blade for the purpose of dividing the cutter force expended at each stroke of the cutter.' And he also claimed making the cutter-bar (meaning the sickle-bar) of angle iron, so as to afford a shoulder against which to abut the sections, so that a single rivet would hold each. February 5, 1856, Abner Whitely obtained a patent in which he claimed 'changing the angle of the fingers and cutters of reaping and mowing machines while machine is in motion, and the finger piece resting upon the ground.'" (1, p. 91)

"One of the men engaged in constructing the Forbush machine was William A. Kirby, and from witnessing the operation of that machine in the field he concluded to get up one that might avoid its defects. The first Kirby machine was completed in 1855; and the first patent was granted April 15, and the second September 2, 1856. The first related to the method of connecting the guard fingers to the finger-bar, and projecting rivet heads and spaces in connection with the cutters and fingers. The second patent contained the important feature of pivoting the main driving and supporting wheel to an arm which was in turn hinged to the frame of the machine concentric to the first gear shaft; which arrangement permitted the wheel to swing on its hinged connection with the gear frame, independent of its and the frame and the cutting apparatus connected therewith to rise and fall independent of the up-and-down motions of the road wheel. A seat for the driver was pivoted to the frame of the machine, and fulcrumed on the axle and its arm, so that the weight of the driver was added to the wheel to give it sufficient adhesion to drive the cutters, and at the same time relieve the cutting apparatus and frame from undue pressure on the ground

when used in mowing. Mr. Kirby, from time to time, improved and perfected his machine, which, like the Ketchum and Forbush, was one-wheeled, with rigid bar, although the latter had a certain adjustability as described. It became by far the most successful of the type." (1, p. 82, 84)

"The patent granted June 17, 1856, to Cornelius Aultman and Lewis Miller, Canton, Ohio, assignors to Ball, Aultman & Co., was a most important one. The original claim was for 'connecting the cutter-bar to the machine by the double rule joint, or the double-jointed coupling piece.' ***** It was afterwards re-issued in six divisions; covering by the two first combinations in which the shoe that carries the end of the finger beam, the hinged brace bar and hinged coupling arm are essential elements; by the two next the arrangement for holding up the bar with its hinge, hinged coupling arm and catch for the purpose of removing the mower from place to place conveniently and securely; and by the two next the ratchet wheel, pawl and spring combination, with two driving wheels and one main gear wheel upon a common axle for holding in and out of gear, as described. Immediately following, August 12, 1856, Ephraim Ball, of Ball, Aultman & Co., aforesaid, took out a patent which, although the claim only covered details of constructions, showed the hinged brace that afterwards, as improved and patented, became well known to the trade as 'Ball's drag-bar.'" (1, p. 91-92)

"William N. Whitely, Springfield, Ohio, November 26, 1856, obtained a valuable patent for self-raking reaper, which was one of the first and best as a 'combined' self-raking reaper and mower. January 27, 1857, M. G. Hubbard was granted a patent on a finger-bar that obtained flexibility through being attached to the frame by two flat spring braces, so that the bar could have a vertical motion independent of the frame, its motion being governed by the surface of the ground. February 9, 1858, he patented an improvement on this device, and March 17, 1857, a shifting seat as specially arranged." (1, p. 92)

"Between the last date (March 17, 1857) and December 1, 1857, when Ephraim Ball's principal patent was issued, several were granted, which as re-issued became of some importance to manufacturers. Ball's patent originally had but one brief claim." (Without an illustration showing reference marks, a recital of this claim would not be clear, hence is omitted.) "It was reissued July 17, 1860, in seven divisions with an aggregate of thirty-three claims. These several divisions and many claims covered hinges, coupling arm brace-bar, shoe and finger-bar in various combinations; the gear wheels and ratchet-wheel, pawl spring and case for these latter in various combinations; the balance-wheel to regulate the crank-shaft, the swiveled pitman, and, in fact, all the features of what was known as the Ball mower. ***** It was an excellent mower, and was the first of its class to obtain a wide reputation as such." (1, p. 92)

John Long, of Ohio, took out a patent December 29, 1857, "that afterwards was assigned and re-issued to Whitely, Fassler & Kelly, and furnished some of the prominent features of the Champion mower. There were two divisions made of the re-issue, but the first claim of the first division covers the principal features: 'The combination in a machine having two independent driving-wheels of a single drag-bar flexibly connected at its front end with the main frame forward of the axis of the supporting wheels, its rear end free to rise or fall independent of said main frame, and connected with the main shoe by two joints, one forward and the other in the rear of the sickle, for the purpose of affording the cutting apparatus firm support, and permitting either end of the same to

rise or fall with the undulations of the ground over which it is drawn' etc. The other claims are for various combinations - chiefly of these features, and also on the slotted retaining link, and other details." (1, p. 92)

"February 16, 1858, to Fred Nishwitz, Brooklyn, New York, was granted a patent that, as re-issued, cut quite a figure among the manufacturers of mowers." (1, p. 92)

"To Lewis Miller, Canton, Ohio, a patent was issued May 4, 1858, that marked an era in the history of mowers. ***** In this machine the essential elements of a successful modern two-wheeled mower, with hinged floating finger-bar, had at last been massed. It had two supporting wheels, each of them equally drivers, and a floating bar made short or stopping at the heel, each end free to rise or fall, with its coupling connection raised off the ground, so as to pass over the cut grass, and with levers for governing its action." (1, p. 93) (The original claims as stated in the last mentioned patent are too long to be included herein.

The Wheeler patent of December 5, 1854 "was re-issued January 3, 1860, in six divisions - covering a laterally projecting finger-bar, hinged to one end or corner of a main frame that is free to vibrate about a gear-center, so that said finger-bar may be permitted at each end to follow the undulations of the ground, and also so that it may rock or roll in the line of its length as well as rise and fall in a line transverse thereto; and making claims for a pitman in two pieces, constructed so that it would not be cramped by the movement of the finger bar, and on other details of improvement and construction." (1, p. 91)

"Previous to the general introductions of jointed-bar mowers, the practical rigid-bar one-wheeled machines readily cut swaths five and six feet wide, but owing to the angles that the pitman had to take in relation to the jointed-bar, on account of its varying movements, it was not practicable to cut a swath more than about four feet in width. The new system brought in and established the narrow cut, and displacing the one-wheeled wide-cut machines by force of custom apparently, also displaced the two-wheeled center-draft mowers - the Eureka, for instance - which carried their width of cut without any difficulty." (1, p. 95)

Although it appears from the records that the adoption of mowing machines when first invented was not rapid, Miller states that "by 1860 the mower had become a thoroughly practical machine, and was being improved by various firms throughout the country." (2, p. 42)

A number of mower trials were held in the fifties, at which various makes of such machines were shown and tested. "A careful study of the reports of some of the mower trials which were held about this time would be of use in showing what machines were then in use and to what degree they were practical. At a trial of mowers and reapers at Springfield, Ohio, July, 1852, three combined machines and three mowers were entered. The combined types were by McCormick, Purviance and Smith, and the mowers by Hussey, Castle, and Ketchum." Both the McCormick and the Purviance mowers were simply their reapers with the platforms removed and their cutters lowered. "The committee gave as its opinion that combined machines were not so good as the separate types. This was undoubtedly correct, for the combined machines soon dropped out of view on the appearance of the mower." According to the Committee's report the Purviance mower "operated quite well" but neither of the other two combined machines did good work. "As to the mowers shown, Hussey's was quite simple and operated well, but required

three or four horses. Castle's, a creditable machine, with a reel and two series of knives, worked somewhat like Bell's old English type. The Committee expressed itself as doubtful as to its operating when the knives became dull. Ketchum's was the simplest and most durable in construction and quite light in draft. It took the first prize, with the Hussey machine second. The report shows that Ketchum had a very practical machine in 1852, with Hussey's a close second. (2, p. 40-41)

"Another trial at Geneva, New York, about the same time, shows Manny's, Ketchum's, McCormick's, Murray's, Rugg's and Danford's machines among the contestants. Manny's had a peculiarly constructed frame, and the knife could be regulated while the machine was in motion. A reel was used, and the cutter sections showed the early efforts to prevent clogging by placing the back part of the edge of each knife in contact with the guard, a modification of the Hussey cutter. Ketchum's had a simple compact construction, with an iron elbow connecting the cutter bar with the running parts of the machine. It was the same style of machine as exhibited in the Trial at Springfield. McCormick's machine had obtuse sickle-edged sections and also the form of spear-shaped fingers patented in 1847. ***** Rugg's resembled the old Bell machine, having the horses in the rear. It had a means of raising and lowering the cutters at will, but soon ceased to operate. Danford's was also used as a reaper, and had a double crank with blades reciprocating past each other. Hussey, McCormick, Cook, and Burrall exhibited combined machines." (2, p. 41)

Another account of a trial held in Geneva, New York, in 1852 is given in (9, p. 287) as follows:- The New York State Agricultural Society "instituted a trial of reapers and mowers at Geneva in 1852, when nine machines competed as reapers and seven as mowers. Only two or three of the latter were capable of equaling the common scythe in the quality of work they did, and not one of them all, when brought to a stand in the grass, could start again without backing to get up speed. All the machines had a heavy side-draught, some of them to such an extent as to wear seriously on the team. None of them could turn about readily within a reasonable space, and all were liable to tear up the sward in the operation. The old Manning, patented in 1831, and the Ketchum machines were the only ones that were capable of doing work that was at all satisfactory." (9, p. 287)

Other trials were held during the next few years. "At a trial in 1855 at Flushing, New York, there were five entries, Manny taking first and Ketchum second prize. At a contest two years later there were five entries - Wood's, Ketchum's, Allen's, Bartlow's, and Harmon's. Ketchum took first and Allen second prize." (9, p. 41)

"Five years after the Geneva trial ***** the United States Agricultural Society ***** instituted a national trial at Syracuse, New York, in 1857. More than forty mowers and reapers entered, and were brought to test on the field. It was soon apparent that striking improvements had been made since the meeting at Geneva. The draught had been very materially lessened in nearly all the machines, though the side-draught was still too great in some of them. Most of the machines could now cut fine and thick grass without clogging, and there was a manifest progress in them, but of the nineteen that competed as mowers, only three could start in fine grass without backing to get up speed. The well-known Buckeye, patented only the year before, won its first great triumph here, and carried off the first prize. ***** Nine years after the Syracuse trial,

another exhibition of mowers and reapers, national in its character, was held at Auburn, New York, under the auspices of the New York State Society, in July 1866. The number of mowers that entered, single and combined, was forty-four; the number of reapers, thirty; or seventy-four in all. It was plain at a glance, that a decided improvement had taken place in workmanship and mechanical finish. The mowers were more compact, simpler in construction, lighter, and yet equally strong; they ran with less friction; the draught was easier, and the machines generally were less noisy; they cut the grass better, and were capable of working over uneven surfaces." ***** In the Committee's report it was stated that "At previous trials, very few machines could stop in the grass and start without backing for a fresh start. At the present trial every machine stopped in the grass and started again without backing, without any difficulty, and without leaving any perceptible ridge to mark the place where it occurred." (9, p. 288)

In an article in Implement and Tractor, (10, p. 14-15, 25) it is stated that "The mower had its genesis in the same experimental period which produced the reaper, one contributing to the other, as the original functions of the two machines were quite similar. The reaper developed through many ramifications into the binder, header, and more recently the combine. The mower is still a mower. But though its functions have not greatly changed, the mower has been gradually improved through the years. Many of these improvements have not ***** greatly changed the general design or appearance of the machine. They have contributed greatly, however, to more efficient and dependable operation. ***** The report of an inquiry into changes in quality values of farm machines between 1910-1914 and 1932, made public in early 1933, showed that the quality of mowers in that twenty-year period had increased 70 per cent. This was the inquiry conducted by J. B. Davidson, G. W. McCuen and R. U. Blasingame. ***** Improvements made during this period involved nearly all working parts of the mower." ***** While the improvements were not particularly noticeable in the general appearance of the machine, "they did contribute mightily to improved performance. Notwithstanding these gradual contributions to better mowing, extending over almost a century, some of the greatest improvements have been recorded during the last two years." (10, p. 14-15)

Among the important changes that have been made, and the results produced thereby, may be mentioned the following: the continuous oil bath for the gears made possible by the use of "dustproof and airtight housings, made such by rawhide seals, etc. ***** Similar seals are also provided for the ground wheels where the pawl and ratchets are protected, and also are thus provided with efficient lubrication." (10, p. 15)

"Longer life is made possible through the use of anti-friction bearings on the crankshaft and pitman shafts, both roller and ball bearings being used generally in the newer mowers. Plenty of facilities for bearing lubrication are provided. The increased use of bearings makes higher speeds possible when desired, contributes to smoother and quieter operation, and maintains such working parts in better adjustment. Better distribution of the weight is provided by the later construction, more of the weight being placed behind the axle in order to relieve the horses of the former neckweight. This has been accomplished to a fine degree, due consideration being given the weight of the operator on the seat and just sufficient weight being placed on the the necks of the work animals to prevent whipping and lashing of the tongue. Probably of greater importance are the changes in cutting mechanism which affect the registration, eliminate side draft and thus make great contribution to a more successful working of the

machine. ***** Better provisions are also made for proper alignment of the cutter bar. ***** Even such minor parts as guards and ledger plates have been improved. The shoes of the guards on many machines have been 'streamlined' so that less resistance is afforded to the flow of the cut grass over the sickle bar. New facilities have been provided for easier removal of the ledger plates and easier installation of new. More serrated ledger plates are used in the newer machines. (10, p. 15)

"A unique departure from conventional types of cutting bars is found in one popular new mower. This involves a shorter distance of travel for the sickle, and increases the speed of the cutter bar. This is claimed to do a somewhat different but more effective type of mowing." (10, p. 15)

"Not so much change has been recorded in tractor mowers during the last two years. Being a more recent development, less improvement has been needed to make them thoroughly modern according to the 1935 concepts of modernism. Some improvement has been made in the transmission of power from the tractor to the mower through the tractor power take-off. These mowers are available in two general types. In one type of machine, the mower assumes the status of an attachment which is carried entirely on the tractor. The other type provides a frame and ground wheels to carry the mower. Each is equipped with safety releases to permit the cutter bar to swing back when an obstacle is encountered which would seriously damage the machine. The tractor mowers can usually be operated at somewhat higher cutting speeds. Other improvements found in the 1935 mowing equipment include greater ease of handling. More positive, easier acting, foot and hand levers are being provided for both horizontal and vertical lifts. ***** New guards have been developed for cutting lespedeza and other crops, the nature of which make extremely low cuts desirable." (10, p. 15)

"Tractor mowers are of four general types. The ground-driven trailer type can be used singly, in series with one or more, or as a trailer behind a power take-off driven mower. The drawbar-attached mower is driven through a power take-off. A third kind is driven by a power take-off that is rear-attached but mounted on one or two wheels. The fourth is driven by power take-off mounted amidships in front of the drive wheels.

"Like all power-driven machinery, these mowers have safety features to prevent damage in case a stone or another obstruction is encountered (the safety release) or when the cutter bar becomes clogged (the slip clutch). Another attachment holds the cutter bar at uniform height up to 12 inches for cutting in rocky fields. For cutting lespedeza, special guards with 1 1/2-inch spacing are available. The ordinary spacing is 3 inches." (11, p. 168)

Various attachments for use with or on the mower have been developed. Among the number may be listed "such units as reaper attachments for cutting grain and special seed crops; buncher attachments for use on hay which is not easily raked; mower tongue trucks; vine lifters for certain crops or for use on matted hay, etc. ***** Special weed attachments" are provided by some manufacturers. "These consist of an adjustable hook which supports the inner shoe, and a wheel which supports the outer shoe above the ground. A special stub guard also is frequently recommended for use on certain weeds." (10, p. 25)

"Inexpensive grinders with tapered stone, which can be attached to the mower wheel in the field" make the sharpening of the knife a much easier and more rapid

undertaking than was possible by the use of the old-time grindstone. (10,p. 25)

Mower-Crusher

Early in 1946 commercial production was announced on a mower-crusher for the speeding up of the field curing of hay. "The field mower-crusher (Haymaker) was manufactured by John Bean Manufacturing Company. This machine mows and crushes the hay in one operation. This is accomplished by having a crushing unit mounted directly behind the cutter bar. A pickup attachment elevates the hay to the rollers where it is crushed. The pressure on the rollers may be varied, depending upon the type of hay, but it should be adjusted so that the stems of the hay are cracked when they pass through the rollers. This permits the moisture in the stems to escape rapidly and decreases the time required to cure the hay." (12, p. 159)

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Cutting Mechanism

- Fig. 1. Modern sickle. The sickle was the first tool used for cutting grass. The early Egyptian sickle was a slightly curved blade fastened at the end of a straight handle. Both iron and bronze blades were used; later the blade was toothed or serrated.
- Fig. 2. The scythe came after the sickle and was first used in the Roman era. Straight handles were first used exclusively for cutting grass. A later development, known as the Hainault, scythe was used for cutting grain.
- Fig. 3. Bailey's mower, 1822. This mower was said to have cut 10 acres of grass a day. The cutting mechanism consisted of a series of scythes laid horizontally on circular framework; they were driven from the left wheel through a series of cogs and were automatically sharpened by a whetstone fixed on an axis above the knives.
- Fig. 4. The principle of the reciprocating knife and slotted guards was developed by Obed Hussey in 1833. His machine, although more associated with the harvesting of grain embodied this principle which, with improvements, is universally used on present day mowing machines.
- Fig. 5. Ketchum's mower of 1847 gave simplicity of design to the mower. Cutting was done by an endless chain of knives which gave way to the more successful design of Hussey's reciprocating knife by which successful operation was attained by Ketchum.
- Fig. 6. The two-horse mower is used for cutting about half the hay crop. The cutting and laying of even, regular, swaths expedites curing and harvesting operations that follow. Enclosed gear box was introduced on one make of machine about 1932.
- Fig. 7. Mounted tractor mower - the cutting power is provided by the tractor engine. This type may readily be dismounted thus releasing the tractor for other work. Mower is equipped with device to prevent breakage if cutter bar strikes stump or other obstruction.
- Fig. 8. Mower-crusher which mows and crushes the stems in one operation, permitting the moisture to escape from the stems more rapidly.

Tedders

"The tedder is another form of implement which was first patented and used in England; but the English tedder was too cumbersome for Western farmers, and our inventors soon produced the light and efficient implements now employed."
(20, p. 7)

According to an account printed in England nearly one hundred years ago it appears that a "hay-making machine" was "invented by Robert Salmon, of Woburn, and patented in 1816." From the description given it seems that this machine consisted of a "series of rakes revolving upon two skeleton frames, to which motion is communicated by cog wheels attached to the naves of the wheels in

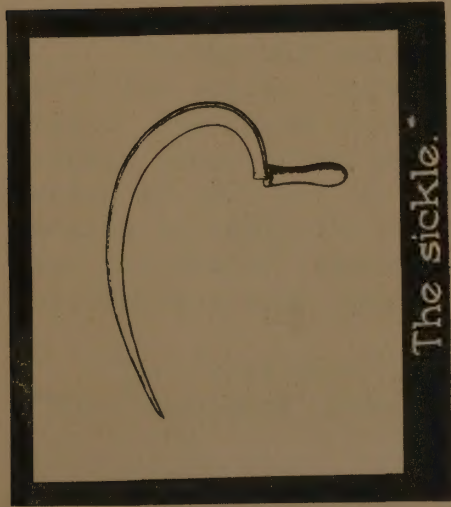
which it travels. It has undergone considerable improvement by R. Wedlake, an ingenious manufacturer residing at Hornchurch. ***** These improvements consist in forming the cylinder in two parts, each of which has motion independent of the other, and in placing the tines or rake teeth upon a bar, which, being supported by a spring, will yield to any obstruction caused by sudden unevenness of the surface of the ground, and return again to its original position. Its object is to spread the hay, and by thoroughly separating its parts, continually to expose them to the sun and wind, which it so thoroughly effects, as to render the hay fit to cart much earlier than by the common process of shaking it by the hand." According to the illustration given with the foregoing description this machine has two wheels, and is intended to be drawn by one horse. (21, p. 1027-1028)

Another English publication after a somewhat similar description of the Salmon machine adds the following details:- "It has two motions, one for tedding the hay or grass, and the other for lightly turning the hay when nearly made. The accomplishment of the reversing or forward action, is obtained by a simple short lever, on the end of which are fixed the two pinion wheels which impart the rotary motion to the flyers. The lever is set for the different motions by means of a thumbscrew fitting into three recesses on the side of the wheelbox, and when an alteration in the action is required, this screw has merely to be loosened and the lever brought to the proper recess, where it is securely held by the thumbscrew; by which arrangement it is impossible for the machine when once set, to work out of gear, without the lever being purposely shifted. The rake barrels are raised from or lowered towards the ground, by means of a lever spanner acting upon two pairs of mitre wheels, placed at the side of the shaft." (22, p. 361)

A slightly different version of the foregoing machine is given by an American writer as follows:- "The hay tedder was invented about 1800 by Salmon, of England, and is more useful in the humid climate of that country than the United States. It consists of a pair of wheels supporting a reel, consisting of an open cylindrical frame, formed by arms proceeding from it and carrying bars set with curved tines pointing outward. This reel may be lifted out of operative position when going to and from work in the field, and when at work it is rotated by a pinion connection to a spur wheel in the hub of one wheel." (8, p. 22)

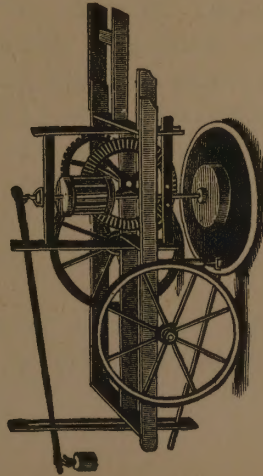
Louden, writing in 1869 states that "The hay-tedding machine ***** invented about 1800, by Salmon, of Woburn, has been found a very useful implement, especially in making natural or meadow hay, which requires to be much more frequently turned, and more thinly spread out, than hay from clover and rye grass. It consists of an axle and pair of wheels, the axle forming the shaft of an open cylindrical frame, formed by arms proceeding from it, from the extremities of which bars are stretched, set with iron prongs, pointing outwards, and about six inches long, and curved. There is a crank by which this cylinder of prongs is raised from the ground, when the machine is going to, and returning from, the field, or when it is not wanted to operate. It is drawn by one horse, and, on the whole, answers as a tedding machine perfectly. In the neighborhood of London, where meadow hay is so extensively made, it is found to produce a great saving of labor, and is now coming into very general use." (12, p-402-421)

After a write-up of the horse hay rake, the following statements are made relating to the hay tedder:- "The tedder is another invention of still more recent date. With the introduction of the mower, by which grass could be cut so rapidly, and the horse-rake, by which it could be gathered more rapidly than



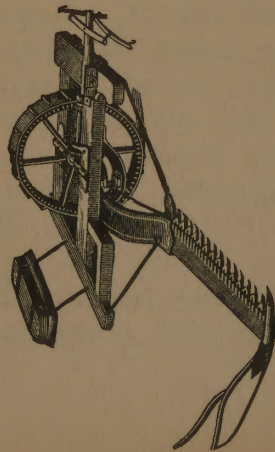
The sickle.

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BAILEY'S MOWER, 1822.

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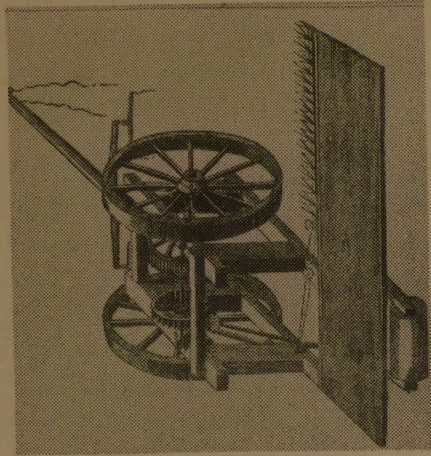


KETCHUM'S MOWER, AS BUILT.

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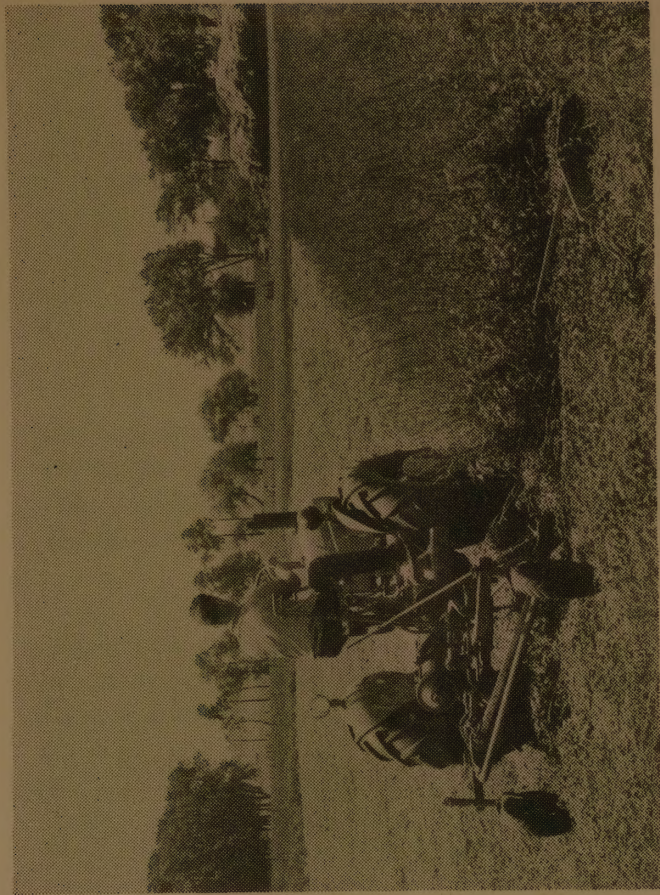
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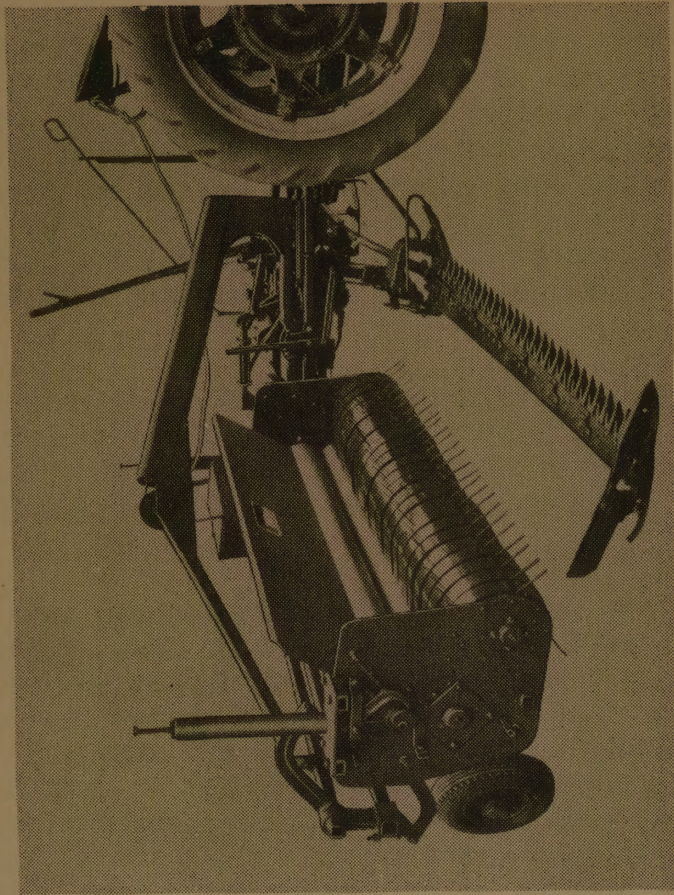
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ever before, there was still wanting some means by which it could be cured proportionately quick, something to complete and round out the new system, as it were, to make the revolution of the process of hay-making entire. Various forms of the tedder had been patented and used in England, but they were too heavy and cumbersome for American use, and it was left to our own inventors to meet and overcome the mechanical obstacles in the way of success here. This they have done, and we have so far economized labor in this direction, that the tedder is now regarded as of nearly equal importance with the mower and the horse-rake." (5, p. 289)

Not much historical data relating to the invention of hay tedders in the United States has been discovered. Butterworth (8, p. 22) states that U. S. patents covering tedders were issued in 1855, 1861, 1862, and 1883, while patents for tedders and rakes were granted in 1865, 1867, 1870, but details concerning these inventions are lacking.

"There are few implements that give more general satisfaction in use, or that are simpler in construction and operation than the hay tedder. The idea of the implement was no doubt conceived by some farmer or farmer's boy as a means for shaking up, by horse power, hay that had lain out in the rain and needed turning so the sun could cure it. But when the tedder had been developed into a practical implement it was found that it had a wider field of usefulness. In mowing, the horses and machine must needs pass over the grass that had been cut, packing it down more or less, and if the hay is left in that condition it dries but slowly and imperfectly, always leaving the under part of swath damp or only partially cured. ***** D. M. Osborne & Co., of Auburn, New York, who are pioneers in the manufacture of mowing machines, have lately brought out a tedder that is made entirely of steel. The frame of this tedder is of angle-steel bar, light in weight but of ample strength. The axle is of 1 1/4-inch steel and is provided with ratchets and pawls in the wheels. It has a steel crank-shaft which derives its power from a gearing placed on the middle of the axle." (17, p. 98)

"The hay tedder is used to turn and loosen heavy hay crops after mowing in order to provide more rapid and even curing. The tedder consists of a number of forks driven by a crank which lifts and throws the hay backward in as loose a condition as possible, as the machine is driven over the hay lying on the stubble. The forks usually have two or three tines, and are spaced about one foot apart. The size of tedders is designated by the number of forks, six or eight being the usual size. In the United States the use of the hay tedder has been largely replaced by the side-delivery rake." (14, p. 225)

Rakes and tedders

"In the hay harvest before the day of improved machinery, the grass was cut with the scythe, spread to cure with the hand fork and gathered with the hand rake. The first break in the hand regime came with the 'whoa-back' rake, a wooden horse-drawn implement. This was followed by the revolving horse rake, which by 1825 was in general use in New Jersey and Pennsylvania, among the first states to adopt it. In due time came the mowing machine, the cylindrical rake, the hay tedder, the mechanical hay fork, and the hay loader, almost entirely eliminating hand operations in the hay harvest." (1, p. 86)

The "whoa-back" rake mentioned above is described in (2, p. 15) as follows: "The 'whoa-back' rake was probably the earliest type of horse rake, the successor

to the old hand rake. The history of this particular rake is not definitely known, but it probably dates back to the 1840's. ***** In dumping the rake it was necessary to stop and bring the horse back a step in order to release the hay for the windrow. Hence the name 'whoa-back.'"

Not all writers on the history of agricultural machinery give exactly the same dates for the invention and introduction of such machines and equipment; neither do they always agree as to the relative importance of different machines. Hence some of the dates and statements relating to inventions mentioned herein may seem rather contradictory.

According to (3, p. 171-172) "As long as hand methods prevailed in the cutting of the grasses there was little need for anything better than the hand rake. The first horse rake was revolving. It did very satisfactory work when carefully handled. But later in the steel tooth rake there was found a much better tool. To Walter A. Wood Company, of Hoosick Falls, New York, is given the credit for bringing out the first spring-tooth rake. Differing from the modern tool, it was made almost entirely of wood except the teeth. The early rakes were dumped by hand, but later an internal ratchet was provided on the wheels, which engaged a latch operated by the foot, and which carried the rake teeth up and over, thus dumping the load. The early rakes were almost universally provided with thills. Finally arrangements were made whereby the thills could be brought together and a tongue made for the use of a team instead of one horse."

In (4, p. 212) the following statement appears:- "The invention of American horse power mowing and reaping machines dates from patents issued as early as 1803, but not until a generation had passed were any effective devices introduced and before 1840 their use was so limited as to have no effect on harvesting costs or crop acreage. A few mowing machines were in use on river flats in Herkimer County, New York, about 1840. In New England they were not in use until after 1850." (4, p. 212)

It may be somewhat of a surprise to read that the horse hay rake ante-dated the mowing machine, but in the report of the Commissioner of Agriculture for 1872, p. 289, the following statement is made:- "The horse hay rake was invented at an earlier date than the mowing machine. It has been used in this country nearly seventy years, and the saving by its use, sixty years ago, was estimated to be the labor of six men in the same time. The work to be performed in raking hay, though slow is comparative light. It does not require the exertion of a very great amount of strength. It is just such kind of work where the application of animal power becomes of the greatest advantage, because it multiplies the efficiency of the hand many times. ***** The labor of a good horse rake is equal to that of 8 or 10 men for the same time, and from 20 to 30 acres a day can be gathered by a single horse and driver, and that without overexertion. In the economy of labor the horse-rake must be regarded as second only in importance to the mower and the reaper, and is considered as essential upon the farm as the plow itself." (5, p. 289)

"The hay crop became of steadily increasing importance in the East, and although farmers must still be content to mow by hand, a machine for raking by horse power gave them great assistance." (4, p. 213)

A writer in 1812 described a hay rake said by the inventor (name not given) to have been "used in the southern parts of the State of New York, which in raking hay on level ground, is believed to save the labor of six men" as follows:-

"The rake is generally made of white oak; the head frame is nine to ten feet in length, and 3 1/2 inches by 2 1/2 in diameter; the teeth are about 2 1/2 inches apart, 22 inches long, and one inch by 1 1/2 in diameter; the one sent" (to the Philadelphia Agricultural Society) "has 30 teeth; there are seven small standards on the head, designed to collect the hay, and are about 18 inches high; there are two curved handles about 3 1/2 feet long." (6, p. 212)

A rake which closely resembles the one above described is said to have been "in use on Long Island as early as 1812, and in Massachusetts and Pennsylvania in 1820." The rake last mentioned does not have the "seven small standards on the head" shown in the illustration of the rake described by Haines. (4, p. 213)

"For raking hay the wooden horse rake, which had been introduced about 1820, had come into common use and was fast superseding the old hand rake. A Connecticut writer reported in 1844 that 'the horse rake has recently been introduced among us with good results, enabling one man with a horse to do the work of five or six with small rakes.' The 'common horse rake' ***** as constructed in 1840 was a simple affair. It consisted of 15 to 18 wooden teeth projecting from both sides of a head-piece. Ropes were attached to this head-piece and the horse was hitched to these ropes. In the center were two handles by which the rake was guided. In use, the teeth ran along flat upon the ground, passing under the collecting the hay. When full, the handles were thrown forward, the rake was emptied, and lifted over the windrow for another load. The 'revolving wooden horse rake' ***** was, however, in more general use. With this the only labor in unloading each rakeful of hay was to lift the handles slightly, causing the teeth to make a semi-revolution and drop the load without stopping. It was said that from 2 to 3 acres of hay an hour could be raked with this machine." (4, p. 296)

"The wooden revolving hay-rake (invented by Moses Pennock, of Pennsylvania, in 1824, and now well known in all parts of the country) also greatly lessens the labor of haying. Fine steel-toothed rakes leave less hay on the ground, but for general use on American farms this wooden revolving hay-rake is one of the most simple, useful, and efficient machines yet invented. On large farms, the sulky wire-tooth rake is fast superseding all other. They throw the windrow into heaps or bundles of 80 or 100 pounds each, ready for cocking or loading. A boy and horse can thus rake and bunch 20 acres a day." (7, p. xxiii)

"Improvements had been made in the horse-rake between 1840 and 1850, by the substitution of iron or steel wire for wood in the teeth, but the wooden revolving horse rake was still the most widely used. In regions where the fields were rough or small, much hay was still raked by hand. The committee on agricultural implements for Norfolk County, Massachusetts, reported in 1849 that through strong attachment to old usage, not one farmer in ten in the county used the horse rake. Ten years later the sulky wire-tooth rake was rapidly coming into use. ***** During the fifties the wheel horse-rake with independent teeth began to come into use. One man could operate it. A Massachusetts farmer wrote in 1856. 'We formerly used the revolver with good success, but for the last four or five years we have used Delano's independent horse rake, and like it better than the revolver, as it is easier for the horses, easier for the person who uses it, and rakes better on uneven land.'" (4, p. 297)

"The American horse rake with curved steel tines attached to a bar hinged to a light axle tree, was first used in Pennsylvania. Those having two sets of wooden teeth lying close to the earth and revolving at the will of the driver were invented by H. N. Tracy, of Vermont. Horse rakes are of several kinds, and have come into extensive use of late years. They are wheeled or wheelers. Some rake heads revolve as in the flop-over rake, in others the rake head is formed by, or attached to the axle or trails behind it, and the teeth are only lifted to deliver the hay. In some the teeth are independent so as to yield to obstacles without affecting the operation of the other teeth. The rake head in some cases is turned by hand at the proper moment, but is more commonly arranged to receive motion from the power of the animal when a holding device is released by the driver." (8, p. 19)

"Haying tools and machinery have participated in the improvement noted in the efficiency of other agricultural implements. The use of the mowing machine was followed by a demand for a more expeditious means of raking. The precursor of the modern horse rake was the wheeled hand-rake. This was followed by the spring-tooth hayrake, the dumping sulky, the draft dumping, the self-dumping, the spring tooth dumping, etc. These implements as made at present" (1900) "by the several manufacturers are substantially similar in general principles and construction. The hand-dumping and self-dumping rakes are the two classes in most general use. These machines are constructed almost entirely of steel, the dumping mechanism of the former being operated by a lever, and of the latter by a foot trip, throwing into connection a ratchet in the wheel to raise the teeth and leave the hay in the windrow. The most recent improvement effected is the side-delivery rake, which is usually used in connection with a hay loader as it leaves at the side a continuous, straight windrow." (9, p. 363)

In (10, p. 224) it is stated that "By 1860 ***** mowing machines were widely used. The wheeled horse-rake had begun to supplant the wooden revolving horse-rake."

That inventors in this country during the nineteenth century were busily engaged in attempts to devise a satisfactory apparatus for raking hay by the utilization of horse power seems to be indicated by the following list of patents issued by our Patent Office, many of which it will be noted were granted during the last half of that century, according to the record as given in (9, p. 362). The list includes the following:- "Flopover, 1822; spring tooth, 1839; dumping sulky, 1848; draft dumping, 1850; self-dumping, 1852; spring-tooth self-dumping, 1856; draft dumping, 1856, 1859, 1866, 1876, and 1884; drag dumping, 1866 and 1870."

It is stated in (11, p. 393-394) that the United States Patent Office issued for the year 1870 seventy-four patents for horse hay rakes.

From an old English work it is learned that horse rakes were used in England, to some extent at least, in the latter half of the nineteenth century. While descriptions are lacking in detail it appears that there were a number of types, as shown by the following statements:- "Raking machines are not in very general use, but where corn is mown, they are successfully employed in drawing together the scattered stalks, and are also of great use in hay making. The saving in both cases consists in the substitution of animal for manual labor. The common, or Norfolk horse rake ***** is employed for barley and oat crops, and also for hay. One man, and a horse driven by means of a line or rein,

are capable of clearing from 20 to 30 acres in a moderate day's work; the grain being deposited in regular rows or lines across the field, by simply lifting up the tool and dropping it from the teeth, without the horse being stopped. The horse stubble rake is a large heavy kind of horse rake, having strong iron teeth 14 or 15 inches in length, placed at five or six inches from each other, and a beam four inches square, and 8 or 10 feet in length. In drawing it two horses are sometimes made use of, by which it is capable of clearing a considerable quantity of stubble in a short time. ***** The couch-grass rake differs little from the last, and is employed in fallowing very foul lands to collect the couch grass or other root weeds. ***** Weir's improved hay or corn rake ***** is adjusted by wheels, and is readily put in and out of gear by means of the handles ***** and bent iron stays. ***** It is drawn by one horse in shafts ***** and is a very effective implement." (12, p. 420)

That inventors were not altogether satisfied with their machines may be inferred from the following statement appearing in (13, p. 276-277). "The improvements in horse rakes are as various as the machines are numerous. It seems as if inventors had exerted themselves to the utmost to develop something new in the shape of a horse rake." An illustration of a one-horse steel-toothed rake, showing the operator riding is given. This rake is said to have been "invented and manufactured by Messrs. Sprout, at Muncy, Lycoming County, Pennsylvania, and has taken several premiums at State Agricultural Fairs as the best rake." (13, p. 276-277)

Sulky or dump rakes

"A large variety of rakes is used in the gathering of mown hay. The simplest of the wheel machines is the hand dump or sulky rake. This machine has a frame from 8 to 12 feet wide supporting a rake bar with teeth made of round steel rods and carried on wheels at either end. The teeth are raised with a hand lever, assisted in some instances with a foot lever. The teeth are spaced from 4 to 4 1/2 inches apart, and are made of 3/8 to 1/2 inch round steel rods. The teeth are made either with a round point called 'pencil point,' or with a flat point called 'chisel point.' Usually one coil is made in each tooth near the top to give greater flexibility. An extra heavy rake is made for raking corn stalks. On the Pacific Coast a heavy rake, called the California type, is made for raking alfalfa, which has heavy flat steel teeth. The hand dump rake is made into a self-dump rake by pawls attached to the rake head which, when tripped, engages ratchets in the wheel hubs, and raises the teeth to release the hay. One or two horses are used to operate the narrow machines - 8 to 10 feet - and two horses for the wider machines." (14, p. 223-224)

In (3, p. 172) it is stated that "Although the first rakes were made of wood, there are now upon the market rakes made almost entirely of steel. The rake head to which the teeth are fastened is usually of a heavy channel bar with a minimum of holes punched through it so as not to impair its strength.***** The rake is always provided with a set of cleaner teeth to prevent the hay from being carried up with the teeth when the rake is dumped. The outside teeth are sometimes provided with a projection which prevents the hay from being rolled into a rope and scattered out at the ends when the hay is very light. Sometimes an extra pair of short teeth is provided to prevent this rolling. Self dump rakes are always provided with a lever for hand dumping. Rakes are made from 8 to 12 feet in width." (3, p. 172)

It is stated in (15, p. 21), that "In this period (1910-14) the external ratchet was abandoned and the internal ratchet placed in the ground wheels. Trip rods were made in two parts, making them reversible end for end. They were made of high-carbon steel and the bent ends hardened. The stub axles were held in line with a clamp bolt. These rakes were considerably improved during the years 1912-13. ***** This was a self-dump rake." Various changes have been made in what has been termed "the basic machines of 1910-14" some of which are listed herewith:- In "1916 cleaner finger fastenings improved to stop breakage and loss in the field." In "1917 the trip spring was redesigned and made heavier and stronger to prevent breakage." In "1920 the foot lever was strengthened. The cleaner finger rod and rod fastening were improved to prevent bending or breaking." In "1924 trip lever arrangement with adjustable trip stop was added to regulate the height of tooth lift for various weights of hay." In "1925 roller bearings were changed from a single bearing to two shorter bearings which were proved to have better wearing qualities and to give more satisfactory service." In "1926 heavier tires were provided. Foot lever support was changed from grey iron casting to malleable to overcome breakage." In "1927 ***** the manufacture of rake teeth was changed to include heat-treatment under thermostatic control, resulting in greater uniformity and longer average operating life." In "1928 dust shields were added to the wheels which prevented dust and dirt from entering and assisted in holding grease in. These added to the life and satisfactory service of the bearing." (15, p. 21)

Other changes noted on a later page of the above mentioned publication include the use of an "internal ratchet which is positive in operation and overcomes the troubles caused by former ratchets changing the former wooden single-tree to one made of steel." The use of a "trip spring which automatically holds trip rod inoperative." Also a "strengthened trip lever made of one piece." (15, p. 105)

At the time the bulletin (16, p. 2) was issued (1927). "The ordinary self-dump sulky rake is used almost exclusively in the western hay regions. The 12-foot size is common where the hay land is smooth, and the 10-foot where it is rough. Some ranchers make a practice of raking in the same direction that the mowers travel, with a rake covering two swaths. The majority seem to prefer to rake crosswise, in which case the size of the rake need have no relation to the width of the swaths. The narrower rake is preferable on rough land because as a rule it does better work under such conditions, is easier on the horses, and there is less strain on the machine."

Side delivery rakes

In a publication that came out in 1894 it is stated that "The side-delivery rake is an invention brought out in recent years to be used in connection with a hay loader. It is difficult to rake the hay with an ordinary sulky rake so that it will lie in long windrows convenient for the hay loader to take it up, and inventors have been seeking a new form of rake that would leave a continuous windrow at the side. One of the first implements of this class to be brought out was the side-delivery rake of the Chambers, Bering, Quinlan Co., of Decatur, Illinois. It is arranged ***** with a crank-shaft resembling that of a tedder, but running forward diagonally. Mounted on this shaft are kick-forks arranged

in gangs of three, there being four such gangs in all. ***** The shaft is operated by gearing and a link belt from one of the forward wheels." (17, p. 96, 98)

Another side-delivery rake which was put on the market by an Ohio manufacturer is said to have been "decidedly novel in its principle and construction. It has three raking reels, which operate in series, and carry the hay to one side. The fingers are long elastic spokes with a hub set below the line of the driving shaft, from which motion is transmitted to the spokes by a driving wheel that acts on each spoke separately through a loose sliding thimble to carry it forward." (17, p. 98)

"Side-delivery rakes are made in two general types, the cylinder and the fork types; the former are in more general use. The cylinder or fork shaft is set so as to rotate on a shaft set about 45 degrees away from the direction of travel, and rotates so as to rake the hay forward and to one side. The teeth are placed about 3 1/2 inches apart. In some instances the direction of rotation may be reversed, so the rake may be used as a tedder. The side-delivery rake is made to handle two mower swaths, the usual sizes being 9 to 11 feet in width. The side-delivery rake rolls the hay from the swath into a light windrow through which the air may circulate." (14, p. 224-225)

It is stated in a Government publication that "The side-delivery rake has one advantage over the sulky rake. When the curing is done in the swath the crew can start taking the hay from the windrow as soon as the side-delivery rake has made one double windrow across the field, whereas when the sulky rake is used they will have to wait until the rake has gone several times across the field." (18, p. 10)

In another Farmers' Bulletin it is stated that "The side-delivery rake is seldom used at the present time in these (western hay) regions, principally because of the higher first cost and because it covers only about two-thirds as large an acreage in a given time as the sulky rake. ***** The side-delivery rake is especially desirable where a mechanical loader is used to load hay on a wagon. Raking hay with a side-delivery rake also hastens the drying process because of the loose windrows which this rake makes." (16, p. 3)

Side delivery rakes and tedders

"The side-delivery rake and tedder, called the 'basic machine of the period 1910-14' is described as a single-speed, side-delivery rake only, without tedder." Several changes have been made in the construction of this rake since 1914. In "1918 the reel drive gear was strengthened." In "1919 internal gear, pawl plated, reel shaft support, and main axle bearing all were redesigned, and made a better engineering assembly." In "1920 adjusting shaft specification was changed from standard agricultural pipe to double strength pipe." In "1922 extra stock was added to reel shaft adjustment lever and eccentric to prevent breakage. Bushing for center support of tooth bar was lengthened and reamed for better wearing quality." In "1924 tooth fastening was strengthened." In "1925 cylinder tooth was improved by using four coils in place of three coils, and heat-treated to overcome breakage. Longer and stronger pole was adopted. Strippers were made more flexible. High-carbon steel was adopted. Brackets and braces were changed to increase rigidity. Substantial parallel control was

provided for extra castor wheel attachment." In "1926 axle strength was increased by keying clutch collars in place of pinning." In "1929 castor wheel design was improved, better bearings were adopted, and steel was used in place of cast iron. Steel quadrant was used instead of malleable." (15, p. 21)

On page 106 of the publication last cited are shown plates of the 1910-14 and 1932 side-delivery rake and tedder. On p. 107 the two machines are compared, and improvements noted, as follows:- "The old rake had no tedding features; it was necessary to perform this operation by hand or with a separate machine. The new machine is left-hand delivery; the windrow is always placed on the stubble when following the mower. The castor wheel was attached to rake with large grey iron bracket. The cylinder adjustment was by means of screw in top of bracket. No additional braces or spring relief was provided for this important member, consequently breakage resulted when machine was operated on rough hay ground. Castor wheel was inadequately shielded to prevent hay wrapping and winding at hub, thus adding much to the draft of the machine unless operator took time to clean frequently. The improved machine was designed to correct above conditions. Pan wheel is closed to prevent wrapping of hay, and is equipped for forced oiling. Brackets that attach it to machine are of steel construction, outfit is adequately braced and relief spring compensates for any roughness of travel. In the old machine the only adjustment for raising or lowering rear end of raking cylinder was by means of screw in castor-wheel bracket. This was changed by substantial all-steel mechanism for raising and lowering the rear end of the cylinder, this mechanism being controlled with an adjusting lever, easily reached by the operator, connected with a rod running back along the truss beam. Formerly the reel shaft revolved in foundry-fit bearings at each end. Pins in gear at front end soon made slots out of round holes in pipe through which they passed, resulting in short life. As improved the pipe is reamed at both ends to provide tight fit for round cold-drawn steel extensions that revolve in self-aligning roller bearing housings at each end of cylinder. Front bearing mounted in malleable stirrup. Connected to convenient lever whereby front end of cylinder may be raised or lowered without leaving seat. Drive sprocket at front end of cylinder is securely pinned and keyed to reel shaft extension, making a true-running durable job. The half oval tires and straight oval spokes with heavy grey iron hub were changed to formed flat steel tires, round staggered spokes and malleable hubs. The grey iron clutch, moved in or out by shifting rod ***** was the only adjustment accessible from operator's seat. This was changed by using a lever whereby front end of cylinder may be raised or lowered without leaving seat. The old machine had 14-degree involute teeth which were noisy and easily chipped. In the later machines heavy drive gears have quiet-running, sturdy, 20-degree stub teeth and are reamed and faced for perfect running fits. The raking and tedding gears are mounted on the main axle and are operated by a heavy malleable double-end clutch connected to a control lever near operator's seat. This lever is locked in three positions - raking, tedding or neutral. The gear nest also houses the heavy drive chain which rotates the cylinder. Formerly the raking cylinder was equipped with 72 single-prong, three-coil, curved wire teeth, spaced 4.9 inches apart, located by inserting the short end of a wood tooth bar to a 3/4-inch pipe shaft which also serves as a stiffener and reinforcement for the pipe shaft, to overcome bowing due to the centrifugal force of the revolving cylinder. Difficulty in obtaining good straight-grained wood bars, and warpage, made it very difficult to hold the teeth in proper alignment, and replacements in the field were numerous. The tooth-controlling malleable cranks riveted to the tooth bars and filler piece, and the riveted stud extending into the eccentric arm became loose after a few seasons of field work. These defects were remedied in the later machines by substituting 45 double-prong, four-coil, straight wire teeth, suitable for raking or tedding. This is equivalent to 90

single-prong teeth. Prongs are 3-3/4-inches apart, which compares with the 4.9-inch spacing on old machines, and results in much cleaner work. Teeth are attached to tooth bar with malleable clamp secured with 5/16-inch carriage bolt and nut of U. S. S. thickness, and to aid in securing these, fastening bolts are nicked to upset the end threads after nut is drawn tight. Teeth are manufactured to withstand a 60-degree slow pull, and snap inspection tests both forward and back without setting more than 5/8-inch from the specified correct position on the bar. Formerly strippers, curved on a hand form and the skill exercised by workmen in bending strippers with eyes at right angles to radius of stripper determined line-up between teeth, when bolted to stripper rails. It was often necessary for purchaser to bend strippers into proper alignment after they were bolted to stripper rails. The changes here included an upset shoulder on stripper. Threaded the end outside of upset, passed threaded end through frame, and bolted it securely. This produced a more uniform product of sound construction. Tooth bars are of 1-inch pipe comparable to the old 3/4-inch pipe reamed at both ends. Rear end has tight-fitting steel gudgeon to run in the cylinder-head bearing. Front end terminates in tight-fitting, forged steel crank that extends into eccentric arm bearings. The end bearings of cylinder heads and eccentric arm are of sufficient length to insure long life. They are grooved to facilitate thorough lubrication. Driving pawls were riveted to wheel hubs, and grey iron clutch shifted by rod in old model. In later type hub sleeves securely bolted to wheel hub. The ratchet portion, forming seat for spring tension driving pawls mounted in heavy pawl plate securely pinned to main axle." (15, p. 107)

In addition to changes noted the following are mentioned on page 109 of publication cited. "Reel shaft extension on latest rake is made considerably longer and is more securely fastened to the reel pipe. The eccentric used on latest rake and is designed with large rollers which provide increased life and reduced draft compared to plain bearing design in old machine. With the addition of the center spider the raking cylinder is substantially strengthened. The older construction did not have this feature. Formerly the axle box had a plain bearing design. As changed a roller bearing is used which increases the life, with less attention required for lubrication. ***** Raking and tedding drive are maintained in proper alignment at all times by being self-contained in the gear housing, which is mounted directly on the axle. On the older rake bearings were fastened directly to the main frame, which did not provide a correct assembly to maintain the proper mesh between gear and pinion. A heavy steel chain is used in connection with the driving mechanism, which in addition to other driving parts, makes possible the combination machine. Bearing boxes are equipped with roller bearings, which on the old constructions were plain reamed grey iron bearings. Self-aligned roller bearings and housings at each end of reel have increased life, and provide an easier running cylinder as compared to the older construction, which used plain grey iron bearings." Referring to the raking cylinder adjustment, it is stated that "The additional levers and quadrants ***** are used on the present machine to more efficiently adjust the cylinder and teeth while the rake is in operation. This feature was not available on the old rake, therefore these parts are additional." (15, p.109)

"A heavy-duty side-delivery rake, rubber-tired and designed for use with tractors, is useful for fast raking and for raking heavy crops. It is sometimes operated from the power take-off.

"Many side rakes are fitted with three-bar reels, but the four-bar rake seems to be increasing in popularity. It rakes the hay more gradually and gently than the three-bar rake does, so that leaf shattering is less, especially if the hay is rather dry." (23, p. 169)

In 1948 commercial production started on power take-off driven side delivery rakes and tedders by the Allis-Chalmers Manufacturing Company and by the New Holland Machine Company. Both of their machines are designed for raking and tedding at relatively high tractor speeds, are mounted on rubber tires, have four bar reels, have anti-friction bearings, and have two reel speeds forward and one reverse speed for tedding.

A side delivery rake appeared in commercial production during 1948 of different construction from the conventional type. It consists essentially of a frame of structural or tubular steel supported by three wheels on rubber tires like other rakes, a series of five or six wheels about 3 feet in diameter which do the raking, with rigid or spring teeth projecting outwardly from the rims. The raking wheels are mounted in a vertical plane, overlapping and nearly touching each other, with their axes at an angle with the direction of travel. The raking wheels are each supported by a coil spring and operate independently of each other, and are turned by the forward motion of the machine. On the West Coast it is known as the "Morrill" rake and in the Middlewest as the "Sargent" and the "Roto-Rake."

Sweep rakes

The sweep rake is an implement which has for some time been extensively used on farms in the Middle West and West, and more recently, especially coincidental with farm labor shortages, by the farmers in the eastern states. This type of rake developed during the first World War was largely horse-drawn. "The sweep rake (19, p. 3-5) consists of several long wooden teeth lying almost flat on the ground, pointed at one end and fastened to a strong framework at the other. The point frequently consists of a steel cap fitted over the end of the tooth, and shaped so as to prevent it from running into the ground under ordinary conditions, yet so as to slip under the hay, no matter whether lying in piles, windrows or swaths. The teeth usually are about 8 feet long and placed approximately 1 foot apart. The total width of the rake ordinarily is about 12 feet, rakes of this width having thirteen teeth. This gives a surface approximately 8 by 12 feet on which the hay can be loaded and carried. Some rakes are made larger than this for use with exceptionally large horses, or, in some cases, with four horses. ***** A skillful driver with a good team of heavy horses will carry loads of from 800 to 1000 pounds. ***** Even where comparatively small loads are carried with the sweep it will be found considerably quicker and cheaper than loading on a wagon by hand except where the hay is hauled a long distance." There are a number of types of sweep rakes - "one with no wheels, one with two, one with three, and one with four wheels. Rakes of the wheelless type sometimes are called 'go-devils.'" (19, p. 6)

"With rakes having only two wheels, or no wheels at all, the horses are always hitched one at each side of the rake, alongside the teeth. With the three and four-wheeled outfits the horses ordinarily are hitched behind the teeth, pushing the rake ahead of them, from which comes the name 'push-rake,' a term commonly applied to these types. The three and four-wheeled rakes have one

feature not found in other types - i. e., the teeth may be raised from the ground after the hay has been loaded on them, thus lightening the draft in hauling the hay, as the weight is then carried entirely on the wheels instead of being dragged, as with the rakes having two or no wheels. This feature also prevents wasting the leaves and heads of the hay on the bottom of the load, and the collecting of dirt. However, with the two-wheeled outfits it is possible to throw most of the weight on the wheels, since the load is counterbalanced, to a greater or less extent, by the weight of the operator. With rakes having no wheels the weight of the hay rests partly on the teeth and partly on the ground, thus making a comparatively heavy draft, although not so heavy as might be supposed, since the teeth act as sled runners and slip over stubbles rather easily." (19, p. 6-7)

"The homemade sweep rake used on most ranches in North Park, Colorado, is made of a heavy frame of planks built around a set of mower wheels. The teeth are made from poles. By means of a balance board on which the operator stands the teeth are raised when passing over rough spots in the meadow." (16, p. 3)

In the natural speeding up of farm operations, characteristic of tractor operation and with the development and use in the late twenties of the power lift the sweep rake became more and more a tractor tool; and later the mechanical power of the old car or truck was utilized for this purpose. These varied adaptations have resulted in rather widespread use of this raking principle. A further commercial development has been the building into the sweep rake of a means of elevating the gathered load so that a moderately tall stack may be set up without the aid of regular stacking equipment.

References: Rakes and Tedders

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Rakes and Tedders

- Fig. 1. The Hand Rake was found adequate so long as hand methods of cutting grass prevailed. There is no definite date as to when this type of rake was first used.
- Fig. 2. Revolving or flop-over wooden horse rake. The teeth run flat on the ground and under the hay which, when a load is collected, is dumped by raising the handles thus causing the teeth to make a semi-revolution and drop the load without stopping.
- Fig. 3. The dump rake gathers the cut hay from the swath and deposits it into windrows where it is more readily loaded. This type of rake has widespread use in all parts of the country where hay is produced.
- Fig. 4. Two swaths cut with mower are thrown together in a single windrow by the side delivery rake. In so doing the loading operation, which follows, is expedited and the drying process, in the windrow, makes for higher grade hay compared with the practice of allowing it to cure in the swath.
- Fig. 5. For large-scale operations the buck or sweep rake operated by tractor is efficiently used. This equipment may travel about the field at comparatively high rates of speed bringing in loads of hay to a central location where it is stacked or otherwise disposed of.
- Fig. 6. With a heavy swath of hay or in the event of rain after mowing there is, frequently, difficulty in curing the hay unless it is first stirred with a tedder. This machine tosses the mowed hay into small bunches through which air can readily circulate and hasten curing.
- Fig. 7. This side delivery rake is driven by the power take-off of the tractor instead of by traction. It has two reel speeds forward and one reverse speed for tedding.
- Fig. 8. In the side delivery rake with rotating tines the raking wheels are turned by the forward motion of the machine.

Loaders

"The hay loader is a machine for gathering hay from the swath or windrow and elevating it to a wagon rack as the machine is drawn after the wagon. It is a machine which saves much hard labor. ***** Several distinct types of hay loaders have been developed. The fork type has a number of oscillating rake bars which gather the hay and slide it by an alternating and forward motion up an incline into the wagon. The rake bars are driven by a crank geared to the ground wheels. By lengthening the stroke, the gearing may be entirely dispensed with, and the rake bars driven by a crank placed on the axle of the ground wheels. Such a machine is called a gearless loader. Another type, called the cylinder loader, has a cylinder with tooth bars for gathering the hay, and an endless carrier of ropes and slats for conveying the hay onto the rack. This carrier is usually placed below the hay, although in a few designs the carrier is placed above the hay stream, with teeth in the slats to draw the hay up an incline. One or two

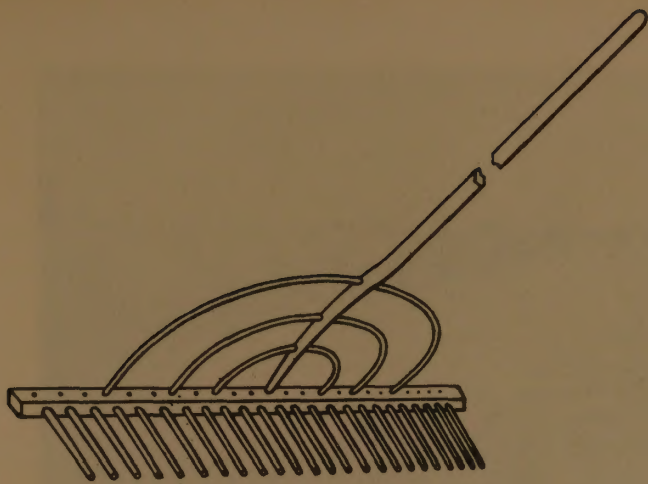
cylinders may be used, and are referred to as single-and double-cylinder machines. In the double cylinder machine, the second or rear cylinder floats over the stubble, revolves against the direction of travel, and acts as a raking cylinder. The teeth are arranged to gather and release the hay at the proper time. A new development of hay loaders is an extension carrier for delivering the hay toward the center of the wagon rack, thus saving labor in placing of the load. The rake type is the least expensive loader, and has an advantage in forcing the hay onto the load, even when it is not removed promptly from the end; whereas, if hay is allowed to accumulate at the end of a cylinder loader, the conveyor tends to drag the hay back with it. On the other hand the agitation produced by the forks of the fork loader tends to shake the leaves from clover hay. For this reason the cylinder loader, which handles the hay more gently, is preferred for clover, alfalfa, and similar crops. Hay loaders are made in two sizes, the 6- and 8-foot sizes. There is a considerable amount of variation in the number of forks provided. The better machines have a forecarriage, while the others are hitched directly to the wagon." (1, p. 225-227)

The steady power provided by internal combustion engines makes motor trucks ideal for the purpose.

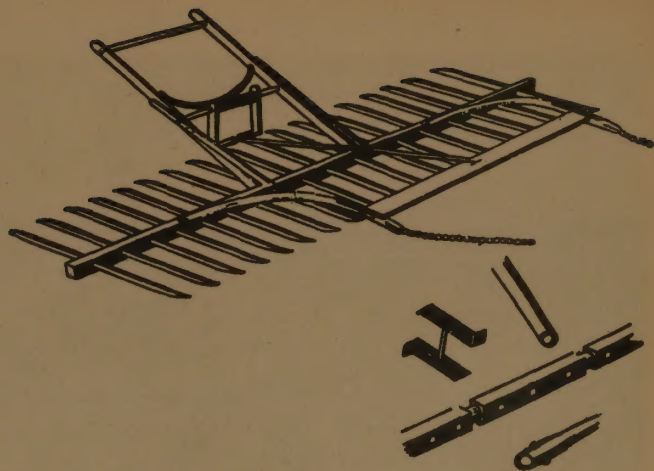
The record (2) shows that a patent was granted in the United States for a raker and loader as early as 1848. This was followed by another in 1850, while a third patent issued in the fifth decade of the nineteenth century was for a reel raker and loader, and was dated in 1858. Six patents are listed as having been granted in the sixties, as follows:- Walking reel loader, 1860; Endless belt loader, 1861; Side-delivering raker and loader, 1864; Lifting drag rake loader, 1865; Raker and loader, 1867; Intermittent action loader, 1868. A patent was granted in 1870 for a Spiral elevator. Another raker and loader patent was obtained in 1876, and this was followed by one for the same type of equipment in 1883.

Although several United States patents covering hay loaders had been issued prior to 1866 it would seem that there was some question regarding their adoption and use. According to a writer in 1866 two New Yorkers are said to have had a "hay loader in operation last season which was supported on two wheels attached to the rear end of the wagon. A kind of sweep-rake gathers the hay into bunches, when a horse-fork, let down from a crane, lifts the forkful on to the load. The hay is elevated by winding the rope around a windlass attached to one of the wagon wheels. The pitching must be performed when the wagon is moving; when standing still the pitchfork cannot be operated. When hay is in cock, or when pitching grain, the fork is thrust into the straw, and the wagon is started, the hay elevated, and the forkful swung around over the load and dropped about the middle of the rigging or load. There is no mistake about the operations of the machine. It will perform all that is claimed for it, so far as raking and pitching are concerned. But whether it will pay on an ordinary farm to make use of such a machine it still a question. The machine has not been tested sufficiently to warrant the indorsement of a labor-saving implement." (3, p. 267-268)

"There are two other hay-loading machines which operate differently from the one just described. ***** One kind is supported on two wheels, and attached to the rear end of the wagon; the other is secured to the fore end of the wagon. In both machines a system of revolving rake teeth gathers the hay and carries it to the top of a kind of straw carrier, when the rake teeth release their hold, and the bunch



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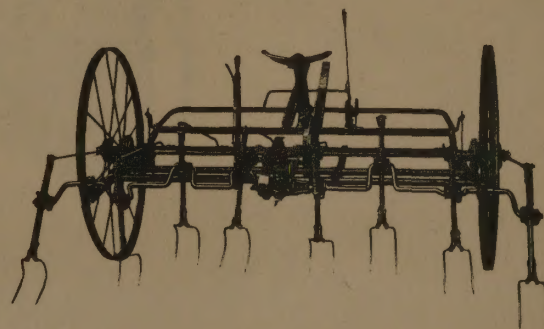
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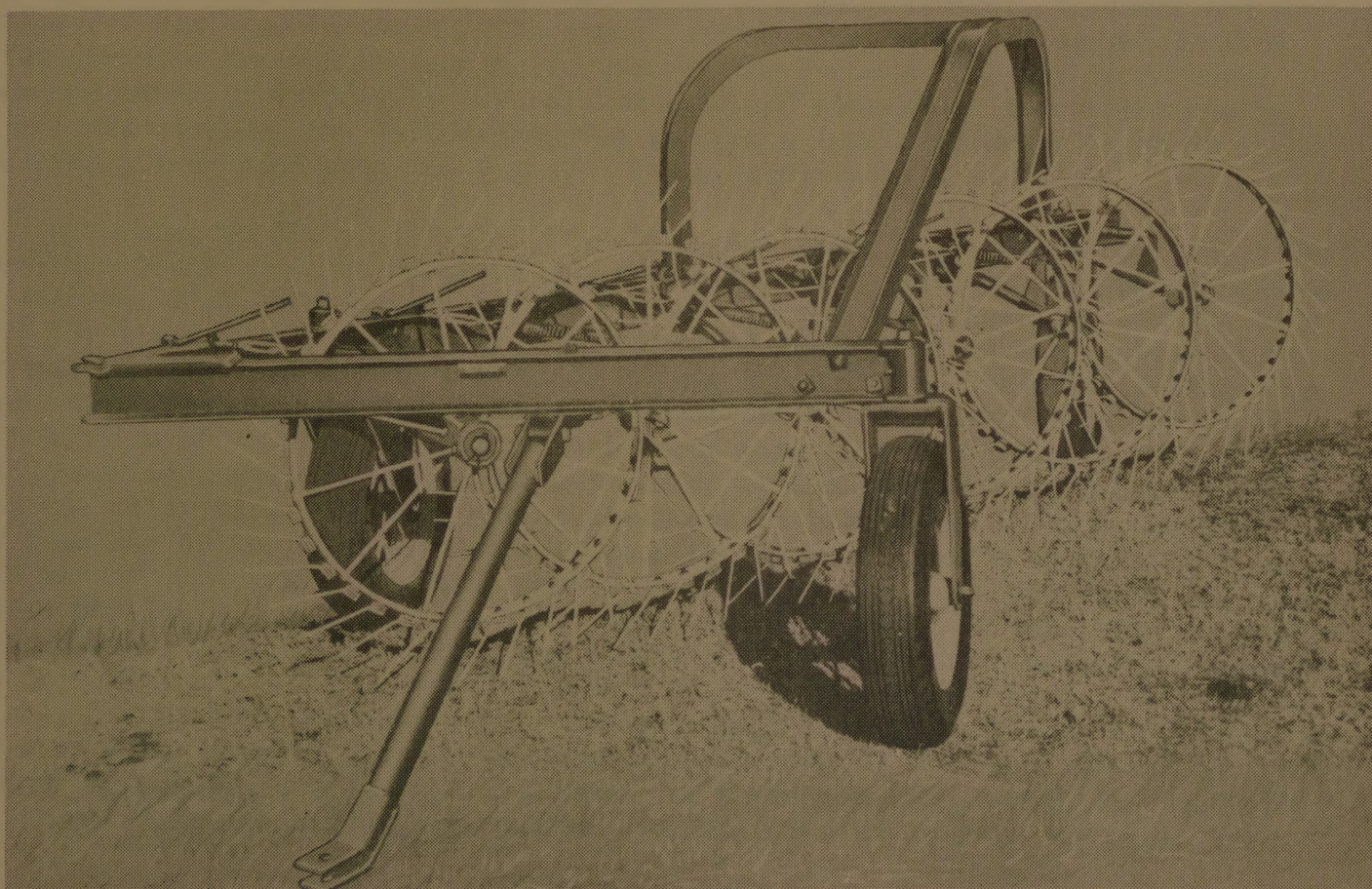
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of hay carried up by each set of teeth rolls over into the end of the rigging or hay rack. One of these machines was operated by driving lengthwise of a windrow of hay, when the numerous rakes attached to the endless belts carried up a stream of hay so rapidly that the loader could not manage it as fast as brought up. Another kind of loader gathers the hay when it is spread out over the ground, and deposits it in a perpetual stream on the fore end of the wagon." (3, p. 268)

"Efforts to produce a practical hay-loader have been made by scores of inventors during the past generation, but until recent years there has been no demand among the farmers that would warrant the manufacture of such an implement on a large scale. About twenty years ago (about 1874) the Keystone Manufacturing Company, of Sterling, Illinois, began experiments in this line, and brought out the pioneer implement in its class. ***** It is mounted on two wheels, and is made to be drawn after the wagon. It has a cylinder with bars carrying hooks like the tines of a pitchfork, designed to lift the hay from the ground and deposit it upon an endless carrier, or apron, which elevates it to the wagon. The weight of the loader gives its two supporting wheels sufficient tractile power to operate the cylinder and elevator. It is claimed that with it a load can be taken from the windrow in five minutes." (4, p. 98)

Another hay loader, described by Ardrey, which was brought out probably about 1890, is as follows:- "It consists of a series of rakes, so mounted upon a crank shaft that they grasp the hay in the swath and draw it a short distance forward on the frame of the loader by the peculiar alternating movement of the rakes. The hooks on the under side of each rake gradually carry the hay to the top of the elevator, where it falls over in a cataract on the wagon. It is simple in design and effective in operation, and has met with a favorable reception." (4, p. 98, 100)

Still another hay loader, put out by an Ohio manufacturer, is described as follows:- "It has, in common with other loaders, the two carrying wheels from which power is derived by gearing to operate the loader. The hay is gathered from the swath or windrow by a revolving rake and elevated a short distance by an endless carrier, the latter dropping it upon a long carrier by which it is elevated and dropped upon the wagon." (4, p. 100)

According to (5, p. 177-178) "In all of the early machines the hay was placed upon the elevating apron by tines or forks attached to oscillating bars extending up over the load. The hay was pushed along this apron by these oscillating bars with the tines on the under side. This form of loader worked very satisfactorily, but had one disadvantage in working in clover and alfalfa. The oscillating bars were unsatisfactory, as they shook the leaves out of the hay. This led to the introduction of an endless apron, which works very satisfactorily in this respect. The loader equipped with oscillating forks is of much more simple construction than the other type. It also has an advantage in being able to draw the swath of hay together at the top, and force it upon the wagon. Loaders of this kind are made without gears by increasing the throw of the forks." Referring to the endless apron loaders, it is stated that "The hay is elevated in this type of loader on an endless apron or carrier after it has been gathered by a gathering cylinder. The main advantage of this type of loader is that it does not handle the hay as roughly as the fork loaders. ***** Provision must be made, however, to prevent the hay from being carried back by the carrier returning on the under side. The apron or carrier usually passes over a cylinder at the under side, which has teeth to aid in starting the hay up the carrier. Provision must be made to enable the

gathering cylinder to pass over obstructions and uneven ground. For this reason the gathering cylinder is mounted upon a separate frame, and the whole held to the ground by suitable springs. The loader has a great range of capacity. All modern machines will load hay from the swath or the windrow, and the carrier will elevate large bunches of hay without any difficulty." (5, p. 177-178)

"The basic machine of the period 1910-14" is described as "A simple hay loader ***** with no gleaning cylinders." Some of the changes made between 1914 and 1932 include the following:- in 1915 "Carrier pulleys designed with wider flanges. King bolt bracket and cap were strengthened. Cylinder made with steel spokes and spring teeth instead of rigid teeth. Trip for tooth-bar added. Carrier was made with deeper vertical slats. Steel tongue was included in place of wood. Carrier pulleys again equipped with still wider flanges. Two steel compressor braces were added for rigidity. Panel plate and pawl seat redesigned. Carrier guides were changed from grey iron to malleable, and carrier shield brackets were added. The drawbar bracket, the king-bolt bracket, and pin, all were strengthened. Cross braces were changed to add stiffness and rigidity. Frame and tongue angles and the upper tie rods were made of heavier stock. Carrier shield was added. Carrier roller shaft was made heavier, and larger bolts were used. Main wheel was redesigned with a malleable hub instead of a chilled hub. Carrier itself was changed to include eleven ropes instead of nine." In 1918 "The lugs were lengthened and lock washers were added on the cylinder head." In 1919 "The cylinder was redesigned, carrier slats and chain were made heavier. A cold drawn axle was substituted for the pipe axle. Roller bearings were added on the main axle and carrier shaft. In 1920 "New adjustable windrow hay loader was designed and manufactured. It had an adjustable elevator with higher side boards, etc." In 1922 "Kingbolt bracket was strengthened by adding more weight. Thicker washers were placed on cylinder teeth." In 1924 "The carrier tightener bracket was stiffened by changing the carbon content of the steel. Hinge studs were increased; compression brace was added." In 1926 "Hinged side boards and steel compressor springs were added to prevent breakage of slats. Hitch bracket casting was strengthened by the additional weight." In 1927 "The U-bolt was increased from 1/2 to 5/8 inch round to hold the brake bracket more securely." In 1928 "Compressor slats were hinged. Shielded sprocket replaced the lower rollers. Extensions were riveted to carrier guides." In 1930 "Cylinder head castings were made heavier to prevent breakage." In 1931 "Wheel ratchet redesigned." (6, p. 14-15)

On pages 76 and 77 of the above reference plates are shown illustrating in considerable detail some of the changes that have been made in hay loaders between 1914 and 1932. Some of the comments relating to the several changes are here given, as follows:- "New machine gathers hay from stubble more cleanly, due to its having approximately 30 per cent more teeth. This pick-up device will, under average conditions save considerable hay. Hay carrier or slatted conveyor on new machine is of much greater value because chain is stronger and more durable, better adapted to its use on cylinder heads or driving sprockets, readily fastens to carrier slat and permits practical application of carrier guides. The carrier is an important member on this loader, as it conveys hay from cylinder teeth to delivery point on the load. Old carrier gave some trouble due to variation in length of chain links; also by stretching in loading operation, which was followed by chain climbing on sprockets with consequent breakage of chain, ropes, slats, and cylinder teeth. ***** Adjustable hay delivery point is of great advantage to operator. Before starting the load, this is lowered and hay is delivered close to hay rack

where there is not much chance for the wind to blow the hay away. As the load of hay rises the delivery point is adjusted by operator, and thus at all stages of loading delivery point is best suited to operator. The adjustment is also useful when machine is to be stored. New loader is a light draft machine. Roller bearings, machined surfaces, and a very rigid frame construction make this possible. The improved frame structure is the result of a better distribution of material." A comparison of the old loader (for convenience called No. 1) with the new model, (No. 2) shows the following changes:- No. 1 "Upper carrier roller shaft - rough pipe had pulleys with rough cored bearings," while No. 2 was provided with "Solid cold-drawn shaft with crank forged at end to adjust height of hay delivery point. Pulleys on shaft are bored and equipped with roller bearings." On No. 1 "No adjustment provided for carrier slide and upper portion of main frame." On No. 2, "Combined to make possible simple adjustment of hay delivery point. Hay carrier equipped with wire chain and inadequate guides" in No. 1. This was changed in No. 2 by being "Equipped with heavy steel sprocket chain guided by frame member and carrier guide. Tongue and carrier guide angle, or that part of frame extending upward through carrier guides and supporting side board and compressor, is more direct and better construction in 1932 (No. 2) machine."

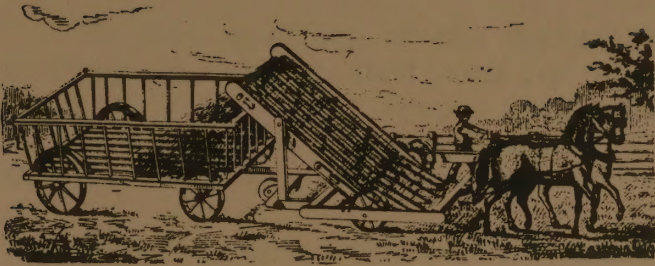
In No. 1 loader the "Forecarriage wheel had half oval tire, straight spokes and cast hub with rough cored bearing." No. 2 "Has concave convex tire, staggered spokes, and removable machined bearing." In comparing "Tongue and frame angles" it is stated that "Well braced, direct connection between forecarriage and cylinder frame and main axle in 1932 (No. 2) machine is great improvement over 1910-14 (No. 1) construction. Positive locking hitch used on 1932 (No. 2) machine replaces an unsatisfactory hitch hook which caused trouble by coming unhitched when the machine No. 1) was drawn over rough places." Referring to "Main axle" in No. 1 which is described as "Pipe axle with cylinder head simply pinned in place changed to Main wheel and axle box fitted on axle with rough cored holes." No. 2 loader is provided with "Solid cold-drawn steel having cylinder heads pinned and keyed in place. Permits close fit in wheel hub, and provides for use of roller bearing. All parts are better aligned and retained in place." Compression frame in 1932 (No. 2) machine is jointed to adjust hay delivery point. Guided by and supported with steel springs. More effective in loading operations. Not subject to breakage and repair through being blown backward by wind, as was the case with the 1910-14 (No. 1) machine." The "Main wheel (of No. 1) had half oval tire, straight spokes, hub and ratchet cast in spokes. Had cored bearing. In case of breakage, or wear at hub or ratchet, the entire wheel had to be replaced." The 1932 (No. 2) model "Has concave convex tire, staggered spokes riveted in hub, and removable ratchet and bearing bored and faced to length, which may be readily replaced. New wheel is standard design and a big improvement over 1910-14 (No. 1) wheel." (6, p. 79)

References: Loaders

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Hay Loaders

- Fig. 1. Hay loader of the vintage of 1850.
- Fig. 2. Cylinder type hay loader. Hay is gathered by a cylinder with
tooth bars and conveyed up the incline by continuous motion
of endless rope carrier.
- Fig. 3. Raker-bar type of hay loader. The rake bars, driven by a crank
geared to the ground wheels, work on the principle of an auto
engine; thus the hay is picked up the incline by alternating
forward passes of the bars.
- Fig. 4. Cylinder type hay loader with gleaning cylinder attachment.
Hay is lifted between the two cylinders onto the slat rope
conveyor and in turn elevated onto the rack.
- Fig. 5. Rake-bar loader. Hay is gathered from the windrow by the for-
ward motion of alternating rake bars pushing the hay up the
incline onto the rack.



Hay loader of the vintage of 1850.

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Stackers

In some sections of the United States either from choice or because of a shortage of barn or shed room for storage purposes, it is customary to stack a large part of the hay crop. Sometimes the hay is stacked in the field near where it was cut, while in other cases it is hauled to a stack yard where seven stacks will be built in close proximity to one another.

While several reports have been found relating to the use of hay stackers, either singly or in combination with other haying equipment, diligent search and inquiry has failed to throw much light on the invention of this type of haying machinery.

It appears from the U. S. Patent Office records that the invention of hay stacking equipment began about the middle of the nineteenth century. According to the records of that office several patents were issued in the late fifties and early sixties, but whether or not any of the machines patented were ever manufactured commercially, or ever came into general use is unknown.

Among the early patents issued by the U. S. Patent Office during the period above mentioned may be listed as following:-

The earliest patents found of record for hay stacking equipment were granted on December 28, 1858, both of which were described as being intended for stacking agricultural products. One was granted to C. W. Glover and the other to J. Van Doren. The address of both of these patentees was given as Farm Ridge, Illinois. (1, p. 1408)

The next patent for this class of equipment found in the record was a patent issued February 25, 1862 to W. M. Mason, of Polo, Illinois, for what was termed a hay stacking machine. F. Wickes, of Kansas, Illinois, obtained a patent on a hay elevator or stack builder October 18, 1864, and this was followed July 11, 1865, by a patent for a hay elevator and stacker granted to A. W. Tooker, of Harvard, Illinois. Three patents were recorded in 1866, two of which were obtained by C. Rundell, of Chicago, the first of which was dated April 24, and was described as a hay and straw stacker, while the other - dated July 10 was called simply a hay stacker. W. Loudon, of Fairfield, Iowa, obtained the third patent in 1866, under date of August 28, for a hay stacking device. Four patents were issued in 1867 which related to the stacking of hay as follows:- To J. T. Breneman, Springfield, Ohio, January 8, for a hay stacker; one to C. H. Tryon, of Greenwood, Illinois, for a hay stacking apparatus on January 29, one to S. J. Wallace, of Keokuk, Iowa, on April 23, for a hay stacker, and one to J. Forshee and J. C. McCland, Unionville Center, Ohio, for a hay stacker, October 29, 1867. Apparently only one patent for hay stacking equipment was issued in 1868, and that was granted to W. S. Nichols, of Rutland Vermont, on January 28. On October 19, 1869, a patent for a hay stacker was taken out by T. N. Bunnell, of Reynolds, Indiana. It will be observed that with one exception - that of Mr. Nichols, - all the others mentioned were granted to residents of the mid-west area. (2, p. 709)

A patent for what appears to have been a more ambitious undertaking, than the others, was called a hay rake, thresher, loader and stacker, and was issued November 30, 1869 to J. R. Hammond, of Sedalia, Missouri. (2, p. 707)

The following statements relating to stackers of various types have been summarized from replies to inquiries addressed to several residents of the Western States.

The replies to some of our inquiries seem to indicate that certain hay growing regions favor types of stackers peculiar to those regions, depending somewhat upon the kind of hay produced. The stackers were probably designed to meet the needs of the individual farmer who built them, as many of them were home made.

Perhaps the stacker most frequently mentioned by correspondents has been the so-called Mormon stacker, or some variation thereof. It has been stated that this stacker has been in use in some sections over fifty years. This is particularly true of Utah - although, there they are more apt to be referred to as hay derricks, swing derricks, or hay stackers.

No inventor has been named for any of the stackers mentioned by our correspondents, nor has any definite date for the invention of any of this equipment been given, but estimates which are considered quite reliable state that these derricks have been known and used in sections of Utah over fifty years.

One correspondent from northern Utah (3) asserts that "nearly every farmer has a Mormon derrick unless the hay is stacked in the barn." He adds that actual inventors are unknown - that "knowledge passed from one farm to another." The writer mentioned has given the following interesting details regarding building the stacker:- "Materials for the derrick, especially the pole, obtained in the higher parts of adjacent mountains. ***** Pole as straight as possible, peeled of bark, but not hewn or dressed. Common length of pole about forty feet; other members of derrick may be undressed logs, or hewn or sawed. Members held together with long bolts or rods. Swivel at top of mast (under pole) usually purchased ready made. Large end of pole fastened to lower part of mast with a chain or cable. Either cable or rope used for handling the load. Four or six tined Jackson fork most common."

An article by J. C. Hogenson, published in the Deseret Farmer (now called the Utah Farmer) several years ago gives the following details relating to a portable swing derrick:-

"The derrick (4, p. 1) ***** has a foundation frame made of small logs or of timbers 10 in. x 10 in.; the frame is 12 feet by 16 feet, with one timber running diagonally through the frame from one corner to the opposite. In the center of this is mortised and bolted an upright log or timber 12 feet high. This upright is braced from the two corners of the frame to which the diagonal timber is attached, and also to the corner opposite the way the derrick is going to swing, or away from the stack. These braces reach the upright timber at a distance of 8 feet from the ground. A long pole is fastened to the top of this upright at one-third distance from the large end. This pole works on a pivot and swings in any direction. The large end of the pole is held to within 6 or 8 feet of the foundation frame with a chain. A pulley is placed on the small end of the pole, another just below where it is pivoted to the upright, and another in the frame on the ground. A rope is run through these, and attached to the fork over the upper pulley. This derrick will build stacks of any size and shape without the hay having to be handled much by the stacker."

It is understood that the chief changes or development of the Mormon derrick has been in the swivel at the top of the upright to one that makes the derrick swing much better, and eliminates much of the creaking when the heavy load is swung. (3)

A Montana correspondent (5) states, in substance, that stackers of various sorts, mostly home made, have been in use in that State a quarter of a century or more. The boompole stacker, the beaverslide, and other types of stackers have been in use over twenty-five years, but no definite date, as to their invention or introduction into use has been given.

In connection with the use of the Mormon stacker in some sections of Colorado it appears that slips with slings are commonly used in the field in putting up hay. The overshop stacker (or some of its various forms) is probably used on the largest acreage, especially in the regions where alfalfa is extensively grown. One probable reason for the popularity of the overshot stacker is that it adapts itself so well to the use of the sweep in conveying the hay to the stack, and is very rapid in operation. In some of Colorado's mountain parks the slide type of stacker is used. The Mormon stacker is reported as being used to some extent in the Arkansas Valley, and rather heavily in the Western slope regions. (6)

Use of hay stacking equipment

The statement is made in (7, p. 16) that "Push rakes and stackers came into general use a number of years ago in the region from about the ninetieth meridian to the irrigated sections of the West. A large percentage of the hay in this part of the country is stacked; and the comparatively large acreages grown, plentifulness of horses, scarcity of farm labor, and desire to make hay with the least amount of hand labor were incentives to the use of these two machines. ***** There are several kinds of stackers, the overshot and swing-around being the most common. Homemade stackers are of various kinds, such as 'gin poles', derrick stackers of different kinds, and inclines for handling hay from the large 1-ton push rakes. The push rake and stacker make an admirable combination, since nearly all of the work of getting the hay from the field to the stack is done by horse power. The push rake takes the hay from the windrow or bunch to the stack, where it is dropped on the stacker and elevated onto the stack by horses. The only hand labor necessary is that of placing the hay after it is dropped on the stack." (7, p. 16-17)

"Hay stackers may be divided into four general types, according to the way they handle the hay. One type is represented by the 'overshot', the 'swinging' and the 'combination' stacker. Each of these has long wooden teeth, like those of a sweep rake. The sweep rake drops its load of hay directly on these teeth, which in turn elevate it to the stack. A second type is represented by the homemade slide stacker and plunger. The entire stacker is constructed of long poles, those forming the slide being placed at a 45 degree angle. A sweep rake delivers its load at the bottom of the stacker, and a plunger with a heavy frame on the front, operated by a team pushes the hay up the slide and onto the stack. The third type of stackers, represented by the cable and derrick outfits, do not receive hay directly from sweep rakes, but handle it by means of horse forks or slings. The material used for their construction is usually assembled on the farm. The fourth type is used only to a limited extent. This type uses ropes to elevate the hay to the stack. Compared with other types it is simple, and requires little, if any, cash outlay for equipment." (8, p. 1-2)

Overshot stackers

"The overshot stacker ***** is so called because the hay is carried up and over the stacker frame and is delivered at one point on the stack. This necessitates considerable moving of hay by hand when the stack is large. Nearly all stackers of this type are constructed of wood. In most instances the stacker is mounted on a heavy frame which serves as a sled to move the stacker from place to place. Some of these stackers are made of extra-heavy material for use where large acreages of hay are put up, and it is customary to load them heavily. A lighter and cheaper type is available for small farms and gives satisfactory service if the loads handled are not too heavy. One style of overshot stacker is made with an inclined front ***** up which the head carrying the hay, mounted on small wheels, travels to the top, whence the hay is dumped on the stack. A device, consisting of springs or weights that counterbalance the weight of the stacker head while the latter is returning to the ground after the hay has been dropped on the stack is a very desirable feature. Without it the team must be backed slowly, holding the weight of the empty head until it reaches the ground. This causes loss of time and lessens the capacity of the stacker. Some styles of the overshot stacker can be mounted on wheels, which allows the stacker to be easily and quickly moved. Often the running gears of an old wagon or truck will be satisfactory for this purpose. When putting up wild hay with an overshot stacker, it is possible to save the labor of one man on the stack by using a contrivance called a 'frontboard and backboard.' In some wild hay districts extensive use is made of this device, of which there are several styles. The frontboard ***** is attached to the stacker, whereas the backboard ***** is built on wheels or shoes so that it can be easily moved about the hayfields. By using this device the front and rear of the stack can be built without much work on the part of the stackman. He must merely walk along the sides of the stack and force the hay down so it will shed water. The ends, being open, are handled in the usual way. This method of stacking enables one man on the stack to handle a quantity of hay which ordinarily requires two men. Frames for the frontboard and backboard should be 10 to 12 feet high, and about 18 feet long, and made of 2 by 6-inch lumber. Smooth, heavy wire is stretched up and down the frame at about 1-foot intervals. Boards may be used in place of the wire, but they increase the weight, and breakage is more frequent." (8, p. 2-5)

"A somewhat similar device, but one that is more clumsy to move, is a wooden box or rack about 16 feet wide, 20 to 24 feet long, and 10 feet high, in which the stack is built. The sides and ends of the box are built separately, or a side and an end may be hinged together. When the stack is finished the rack is taken down and folded flat on the ground for moving." (9, p. 17-18)

"The overshot stacker is well adapted to building stacks of different size, and is perhaps more popular with the average hay grower than is any other type. ***** When mounted on wheels (it) can be moved to a new stack site in a few minutes. ***** With this outfit stacks ranging up to 30 tons or more can be built. For stacking alfalfa or mixed hay most crews consist of five men. The hay is brought in to the stacker by two sweep rakes. Two men stacking the hay and a man or boy to drive the stacker team ***** completes the crew. From 30 to 40 tons of hay are stacked by this crew in one day. In localities where wild hay is put up, and the frontboard and backboard are used with the overshot stacker, a crew of five men ***** using two sweep rakes to haul the hay from the windrow to the stacker, "one man on the stack, a man or boy to drive the stacker team, and a man to rake the scatterings - completes the crew, which puts up

about 32 tons of hay daily. By adding two sweeps to the crew about 60 tons of hay are put up daily." (8, p. 5)

Swinging stackers

"The swinging stacker ***** has a head for carrying the hay which swings sidewise and upward instead of vertically, the hay sliding off the ends of the teeth when being deposited on the stack. Otherwise it is somewhat similar to the overshot type. The principal advantage of the swinging stacker over the overshot is its ability to deliver the load of hay to different parts of the stack, thus reducing the amount of work required on the stack. With some styles of swinging stackers it is possible to load from either side at the will of the operator, so that the sweep rakes do not interfere with each other as much as when using other types. With a good operator, this stacker has perhaps greater capacity than any other type, for as many as six or eight sweep rakes can be used with it. In the hands of a poor operator it is an unsatisfactory type to use. ***** Some swinging stackers have a weighted box on the lower end of the swinging arm to counterbalance the weight of the head." (8, p. 5-6)

"With the swinging stacker, the same sizes of stacks can be made as with an overshot, and this stacker has the same advantage that the overshot has namely it can be used with a small or a large crew. But it cannot be moved as quickly as can the overshot stacker that is mounted on wheels." (8, p. 7)

Combination Stackers

"A combination of sweep rake and stacker does the work of both. This style of stacker is mounted on wheels and operates by being driven over the ground. An elevating mechanism is engaged when the stacker is about 80 or 100 feet from the stack, and the rake with its load is then lifted, as the stacker advances, until it is high enough for the load to be deposited upon the stack. ***** The combination stacker can be used to take the hay from the windrow, swath, cock or sweep rake, and place it on the stack in the same way as does the overshot stacker, but with the combination stacker the hay can be placed on any desired part of the stack. ***** It can be used to advantage to load hay from the windrow or cock on wagons when labor is scarce, or when the distance is too great to haul the hay with the stacker or the sweep rake. Its most common use is near the stack, where it handles the hay brought in by sweep rakes. When starting a new stack with this style of stacker, no time is lost in moving or setting the outfit. In building a stack, the hay can be placed at either end or at either side, thus allowing a change of position if the wind shifts during the stacking operation. This stacker, in comparison with others, has a rather low daily capacity, together with a higher first cost. When used to bring in hay from the windrow or cock in meadows that are rough and uneven, because of its excessive weight, this outfit is hard on the team, and does rather unsatisfactory work. ***** Stacks of any desired length can be made with the combination stacker without necessitating any extra labor on the stack, because with this stacker hay can be placed on any desired part of the stack, from either side or either end. It can be used to build very small stacks as easily as long ones. The extreme height of stacks made with the combination stacker is from 20 to 23 feet." (8, p. 7-9)

Slide stackers

"The slide type of stacker, which is a homemade outfit built like a slide, is constructed entirely of poles from which the bark and all rough spots have been removed, or is made from smooth boards and timber, and mounted on slides. A plunger which elevates the hay completes the outfit. Three styles of this stacker are in use. The first, which is perhaps the most efficient, is fan shaped, being wider at the top than at the bottom; ***** the second is the same width throughout, and the third has a solid slide built of smooth boards. ***** In the pole styles the lower six feet of the slide is usually constructed of movable sections of six to eight teeth each. These sections can be lifted and shoved back into the body of the stacker when it is moved to a new set. The poles on the remainder of the slide are continuous. Most slides have a guard rail on each side to prevent the plunger from running off when the hay is being elevated. The elevating device consists of a plunger ***** constructed of a pole about 35 feet long, on the front of which is a heavy frame of poles or timber about 12 feet wide, 3 feet high, and 12 to 16 feet long, mounted on two wooden rollers to reduce friction. The team is hitched to a doubletree attached by a swivel on the opposite end of the pole. This allows the team to be turned around when the plunger is pulled back for each load. The use of pole slides is rather closely confined to certain localities in Colorado where a large tonnage of wild or mixed hay is stacked with them. The other style is used in sections along the Pacific coast. With this type of stacker, hay is delivered at the base of the slide. ***** The plunger is then started forward ***** and pushes the hay up the slide and onto the stack. ***** By driving the team at different speeds the hay can be made to fall either at the front or the back of the stack. With the fan-shaped slide large stacks are more easily built than with the other styles, as the plunger driver can deliver hay near either end of the stack, which saves the stack men a large amount of work. As these stackers handle large quantities of hay very rapidly, two or three men are usually required on the stack. A heavy team is needed on the plunger, which together with the hay makes a considerable load." (8, p. 9-10)

"Slide stackers are used for putting up both wild and mixed hay in limited localities of the West, but could be used equally well in certain other localities. ***** The greater capacity of each sweep when a slide stacker is used is caused by the fact that the hay can be left at the foot of the slide, as the plunger is able to pick up the hay and push it up on the stack. With all other types of stackers it is usually necessary to give the hay a push after the sweep has placed the hay on the stacker head and has backed away." (8, p. 11-12)

"The use of the slide type stacker ***** is confined almost exclusively to the vicinity of North Park, Colorado, although a somewhat similar stacker is used in certain sections along the Pacific Coast for loading hay on wagons." (9, p. 8)

Cable stackers

"The cable type of stacker is one of the simplest and most generally used of the homemade haying appliances. ***** The A-shaped frames are usually made from poles that can be obtained on the farm or in the neighborhood. The remainder of the material can be bought ready for use from most hardware dealers. Ordinarily the material that must be bought for this outfit consists of one reversible cable carrier; one double harpoon fork, or grapple fork, or the required number of slings; 150 feet of half-inch galvanized steel cable, on which

the carrier travels, and which is used also for end guys; two cable clamps; two long bolts to bolt the tops of the poles together; three steel-yoke knot-passing pulleys; 130 feet of 3/4-inch manila carrier rope; and 65 feet of trip rope. The height of the stack that can be built with this outfit depends upon the length of the poles used. Poles 32 feet long will serve for most conditions, although poles 60 feet long are used in the far West. This is a satisfactory type of stacker if hay is stacked each year in a yard adjoining the feed lots. Many farmers use it when unusually large stacks are built in a permanent location, whether near the feed lots or in the fields. ***** To move and set up a cable stacking outfit requires considerable time, and ordinarily fairly large stacks should be made in order to prevent loss of time by the crew while waiting for the stacker to be moved. ***** The ordinary cable stacker is capable of making stacks up to 40 feet in length, and longer ricks can be made when an extra long cable is used. The width of the rick varies from 12 to 20 feet, and the height varies from 20 to 30 feet. The contents of the stack may be anywhere from 10 to 30 tons or more. ***** With larger outfits, such as are used in the West, stacks up to 200 tons are made with the cable stacker. ***** The rate of stacking with a cable stacker is about the same as when hay is put into a shed or barn with a hay carrier and sling or fork. The difference is that only one man is needed to handle the hay in a shed or barn, whereas two are required on the stack. A crew of 3 men on sweeps, 2 on the stack, 1 trip-man, and a stackerteam driver will put up 35 to 40 tons daily. The sweeps drop the hay on slings which take up the entire load of 700 to 1,000 pounds at one time. When wagons are used the hay is loaded with a hay loader and 2 more men are required, but the daily tonnage handled is no greater." (8, p. 13)

Derrick stackers

"Derrick stackers are used to a considerable extent in the Western States, and are especially adapted to alfalfa if the hay is cured in the cock. ***** These stackers are all homemade outfits, therefore considerable variation occurs, and many styles are found. According to men who have used different stackers, the derrick excels all others for handling alfalfa hay if it is hauled to the stacker on slips. With this method there is a minimum loss of leaves from shattering, and a saving of labor on the stack. Perhaps the best of these stackers, and the one in most general use, is the Mormon derrick. (8, p. 13)

Large stacks can be built with one type of the Mormon derrick stacker, which has been "widely used in the intermountain States." This outfit "is easily moved, as no guy wires are needed for support. Slips are used almost entirely for transporting hay to this type of stacker, although wagons can be used. ***** Another style of Mormon derrick has a different bracing; the boom and upright turn together." (8, p. 14)

"The Wilson derrick ***** is a lighter outfit than the Mormon. This stacker requires three supporting cables attached to the top of the pole and to stakes driven in the ground, therefore more men and time are required to move to a new set." There are a number of variations of the Wilson derrick, in one of which "the boom pole ***** is fixed to the upright, thus giving but one adjustment." In another style of the Wilson derrick "the framework at the bottom allows it to be moved more easily than the unsupported style." (8, p. 13, 16-17)

"Wagons for long hauls and slips for short hauls are used almost exclusively when hay is stacked with a derrick or pole stacker. A hay slip is a contrivance for transporting hay from the field to the stack. Slips are used almost exclusively with derrick stackers for putting up alfalfa, as they do away with excessive leaf shattering, and prevent dust and dirt from mixing with the hay, thus improving its feeding and sale value. Slips are made in two styles, each having a platform 8 feet wide by 16 feet long. In the simplest form the platform is constructed of 1-inch boards held together on top by four 2 by 4 cross pieces. A better form is built on runners, and lasts longer than does the former as the runners can be replaced. In operating a slip, a sling is placed on the bed, or two chains on the bed, one on each side. The hay is then pitched on the slip, which has a capacity of 1,000 pounds or more. When the slip, which is pulled by two horses, reaches the stack, the chains or slings are hooked to the pulley on the stacker, and the entire load is elevated at one time." (8, p. 15-16)

"It is possible to use a sweep rake with a derrick stacker, but if this method is employed to deliver the hay, the slings used to elevate the hay must be sunk flush with the surface of the ground. The sweep can then be driven onto the slings, and can deposit its load and back away without disturbing them. ***** The size of stacks made by the different styles of derrick stackers varies considerably. Small stackers of this type are often too low to permit the building of tall stacks. Stacks built with these outfits may contain from 10 to 30 tons. Some of the larger stackers used in the West, like the Mormon derrick, build stacks of 80 to 100 tons, and as high as the cable stackers build. Stacks made by derrick stackers are, in general, not as long as are those made by the cable stacker, because of the large amount of labor required in moving the hay to the ends of the stack. Long stacks sometimes are made by making a bench of moderate length, say 30 feet, and then moving the stacker so that the next bench can be jointed to the first one. Derrick stackers of the Mormon style are almost exclusively used in some Western districts in which both large and small acreages of alfalfa hay are grown. They can also be used satisfactorily for other varieties of hay." Still another type of home-made derrick stacker is mounted on wheels. This large, heavily constructed stacker can handle very large loads of hay, and can be moved quickly to a new stack site. Another homemade outfit is called a pole stacker, and is said to be capable of making a very tall stack. As the hay leaves the wagon the stacker turns, and the hay is swung over the stack and dropped at the desired point. Stackers of this type must be held by heavy wire guys. (8, p. 16-18)

Tripod stackers

"The tripod stacker is the simplest and perhaps the most easily constructed of all homemade stackers. Three poles about 30 feet long are bolted together at the top. ***** The bottom is spread out far enough to permit a stack of the desired size to be built under the tripod. The equipment consists of three pulleys, a hay rope, a trip rope, and a horse fork. It is not necessary to use guy wires to hold this style of stacker in place, as with some of the derrick and pole stackers. The tripod stacker is not adapted to making long or high stacks, and often is used by small crews. This stacker, as well as the cable type, is generally used for stacking hay that is hauled to the stack on wagons. Tripod stackers are easier to move than the cable or derrick stackers, which require the use of guy wires, and for this reason they are generally used for building comparatively small stacks." (8, p. 19)

Rope stackers

"Rope stackers, somewhat common in parts of western South Dakota, are used for alfalfa or mixed hay in conjunction with sweep rakes or wagons. Cheapness and lightness are perhaps the only advantages of this type of stacker. In constructing this stacker three ropes about twice the length of the ordinary stack are fastened to an iron ring. This ring is put over the head of a stake driven into the ground at one end of the stack (far enough away to allow a sweep rake or wagon to drive between) and the three ropes are passed over the stack. A sweep rake delivers a load of hay on the ropes and is then backed away. A fourth rope, placed over the top of the stack and the load of hay, is hooked in the ring, which is now lifted from the stake. A team is hitched to the other end of this rope, and when driven ahead the hay rolls up the stack. The other ends of the three ropes are held by the man on the stack, two in one hand and one in the other. If one side of the load rolls ahead of the other the rope on that side is slackened and the rope on the other side is tightened. When the hay is in the desired place on the stack the ropes are released and the hay remains on the stack as the ropes are pulled from underneath. The man driving the team throws the ropes back to the man on the stack, who arranges them for the next load. If a wagon is used instead of a sweep, the hay is rolled off the rack by means of ropes. Stacks built with rope stackers are built low at the end where the load is rolled up, and high at the opposite end." (9, p. 13-14)

"When using a sweep or push rake difficulty is sometimes experienced in removing the load from the teeth when backing away from the stacker. When the load refuses to slide off the rake teeth it is usually necessary for a man to climb onto the rake and, with a fork stuck into the ground between the teeth, to hold the hay while the team and rake are backed away from the stacker head. To eliminate this difficulty a light frame made of rough boards ***** is attached to the rake teeth. The frame fits in between the wheels of the rake with about 1 foot clearance between the ends and the wheels. A board running parallel with the rake teeth is fastened to the bottom of the frame, and this in turn is attached to the body of the rake by means of a chain. The chain is of such length that when extended the frame is held about a foot back from the ends of the rake teeth. On the back end of the board is attached a pointed iron rod. This rod is attached at an angle with the point towards the rear of the rake. When the rake is empty and is being driven ahead the iron rod drags over the ground, causing the frame to slide to the back of the teeth. When the loaded rake is on the stacker head and the team is backed, the iron rod catches in the ground and holds the frame, which in turn prevents the hay from coming back with the rake." (9, p. 16-17)

References: Hay Stackers

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Stackers

Fig. 1. Overshot stacker. Stacker is loaded on the ground by sweep rake after which the load is elevated and "over-shot" to the stack by means of rope and pulley operated by truck.

Fig. 2. Slide stacker. Hay is gathered from field and placed at base of slide. A plunger arrangement operated by 2 horses pushes the load up the slide to the top where it is handled by the stack builders.

Fig. 3. Combination sweep and stacker. After the load is gathered in the sweep it is brought to the stack where it is elevated by the mechanism. This machine has a capacity of 2 buck rakes and elevating reach of 25 feet. The horsedrawn type is being superseded rapidly by the power type.

Fig. 4. Portable Mormon Derrick. This is easily moved to different locations where it is desirable to build hay stacks.

Figures 5 to 8 Combination stackers. These tractor-mounted stackers are used to pick up the hay in the field and carry it to and place it on any desired portion of the stack. The lifting mechanism is either hydraulic or mechanical in operation.



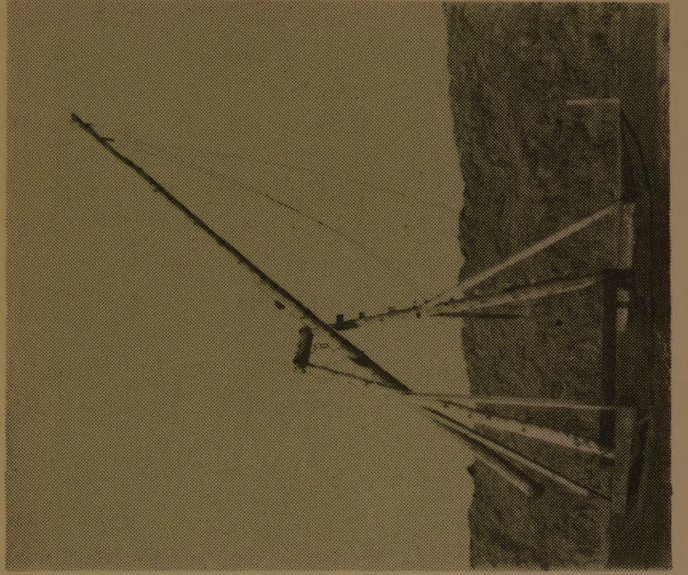
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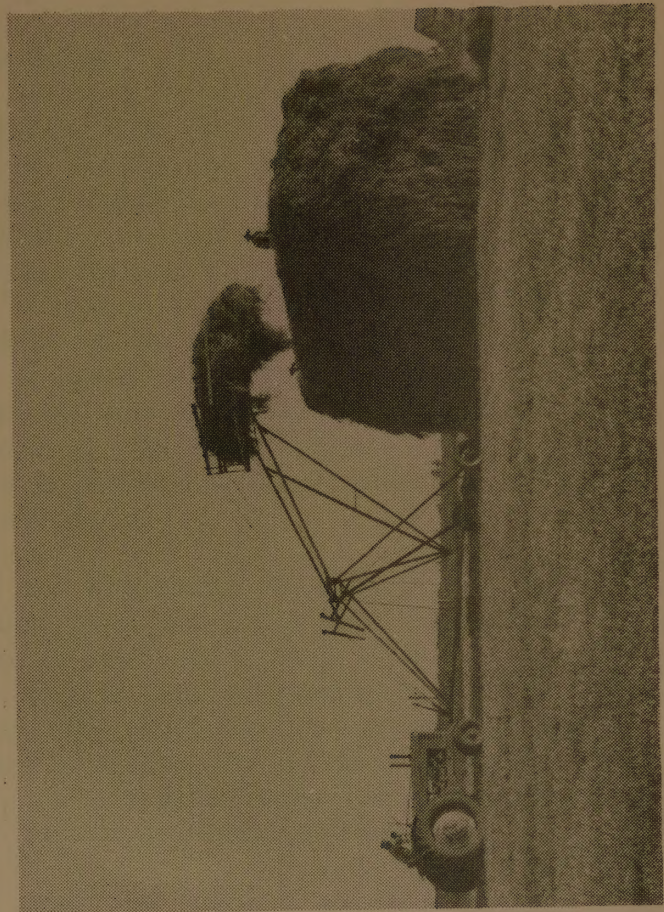
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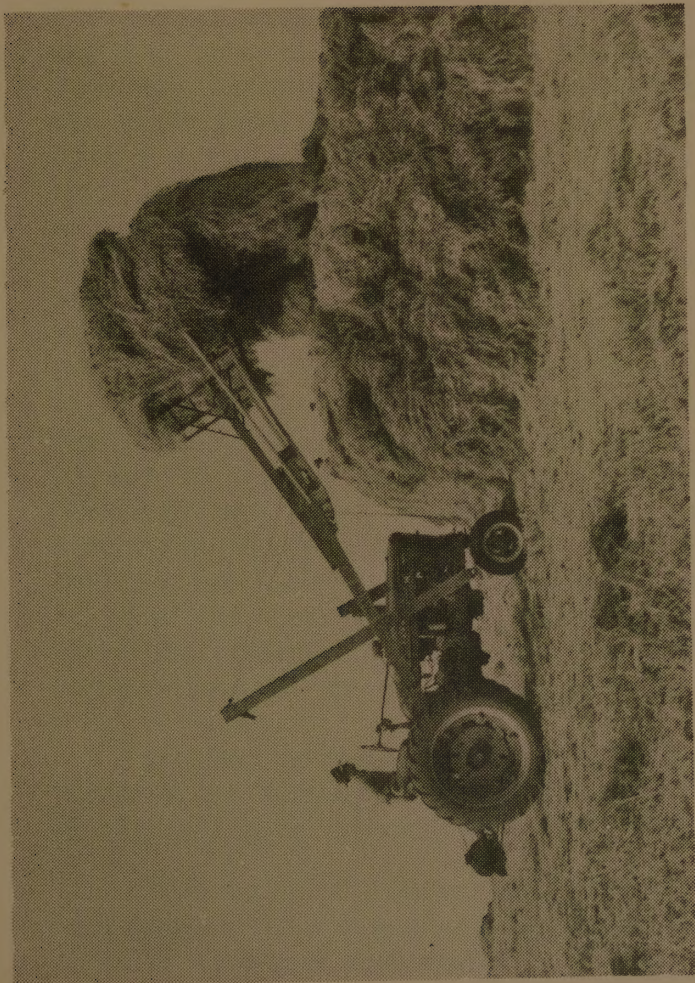
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Hay and straw balers

Records in the United States Patent Office show that a patent for a hay press was issued to R. V. W. Thorn, of New York City, as long ago as April 29, 1813. A fire in the Patent Office in 1836 destroyed a great many records, and no details regarding this patent are available. Another patent was granted January 26, 1828, to M. B. Bliss, of Pittston, Maine, details of which are also lacking. Two patents were granted in the 'thirties - one to A. R. Chamberlin and A. Cleflen, of Richmond, Maine, under date of March 30, 1836; and one listed in the Patent Office as an "improvement in presses for compressing hay and other substances, (also classified as a cotton press) was patented to C. W. Hawkes, of Brunswick, Maine, on April 18, 1839. Some of the early patents covered machines that apparently were intended to bale cotton, hay, or other substances. A few patents were granted in the eighteen-forties.

The facts just stated seem to support the statement made in (1, p. 18) by a writer who in speaking of the patent issued to H. L. Emery, of Albany, New York, in 1853 describes the inventor as a pioneer, but adds that "evidently considerable progress had been made by others before him, otherwise his press would not show so many advanced features." (1, p. 18) An illustration of the Emery press is shown in (1, p. 17). This machine is called "H. L. Emery's newly invented, double, toggle-jointed, horizontal, progressive lever hay and cotton press, and is described in the publication just mentioned as follows:-

The illustration shows the horizontal press is "closed up, and about midway in process of compressing a bundle of hay. When fully pressed home, the ends of the levers which are seen at each end, extending above the box, are brought down by chains or ropes, and shelves, until the levers themselves become horizontal with the floor. The press is provided with two followers, both working from the ends toward the center, and each other. The chains or ropes from the levers are connected together by passing one of them under the machine, and both joining in a larger chain or rope - this larger one being connected with a capstan, or blocks and ropes as most convenient. When the press is driven home the hay becomes pressed into a bundle standing on its end. The side doors are thrown open while the bands are passed round the bundle and secured, when the top doors are loosened and the bundle thrown out. For operation the levers are raised, the followers drawn back and the top doors opened from the center to each end by unbuttoning the middle cross bar. ***** The opening on the top for receiving hay is two feet wide and eight feet long. The press stands upon the floor or ground when in use, which makes it both convenient and capacious for filling and treading in the hay. The whole press measures 14 feet long, 2 feet 10 inches wide, 4 feet 10 inches high, outside measurement, and weighs complete from 1200 to 1500 pounds, and is capable of compressing 250 pounds of timothy hay into sixteen cubic feet (being 2 x 2 x 4 feet) at the rate of five bundles per hour with two men and one horse, and larger bales in proportion as to size and time required. For transportation, the inside work is easily removed and boxed up, while the sides are packed together making solid cubic measurement of the whole thing. (1, p. 17-18)

Another pioneer inventor of a hay press was P. K. Dederick, of P. K. Dederick & Company, also of Albany, New York. In speaking of the hay press Mr. Dederick is reported to have said that:-

"Twenty-five years ago" (about 1863) "but little hay was railed - some railroads even refused to carry it - and large cities received their supply chiefly by water and wagon." (1, p. 19)

The article from which the foregoing extracts are taken continues as follows:-

"Twenty-five years ago hay was baled only to a limited extent in a few localities along the Eastern seaboard, and occasional locations of heavy stationary hay baling and shipping establishments at the West. What portable presses there were would not load enough hay in a car to make it practicable to ship long distances, and presses as then constructed required such weight of material in order to obtain sufficient strength and power to properly load a car, that they were too heavy to move. All of these presses were upright, or perpendicular box presses, forming a single bale, which was then tied off and removed, and the press adjusted preparatory to commencing another bale, and slow movements and methods of operation necessitated large bales, which could be handled only by rolling about through the dirt; and in feeding required the pulling and shaking apart of a condensed mass of hay. ***** Before the improved horizontal presses came into general use Mr. Dederick had been making upright presses, hand, portable, as well as stationary, in considerable numbers." It is believed the hand presses were all of the upright class. (1, p. 19)

"In 1872 Mr. Dederick introduced his Perpetual press, which, as he claims, was the first successful horizontal baling press, and the first to pack and complete a bale in charges with a continuously reciprocating traverser. He further says that 'this invention not only made it possible to load grain cars with a portable horse press, but also reduced the cost to a farmer of a machine that would do such work about one-half, or to \$250, to \$300.'" (1, p. 19)

Other men became interested in building hay balers or presses, one of whom was Mr. Ertel, of George Ertel & Company, of Quincy, Illinois. Like Mr. Emery and Mr. Dederick he is described as a "pioneer inventor," and manufacturer. Mr. Ertel is reported to have said in substance:- I made my first hay press in 1866, and, like many others, I first got interested by mere accident in what afterward became my life's work. Mr. Ertel took out a patent in 1867. This press had the beater hoisting wheel on top of the wooden shaft. He made about 500 of this style when he improved the machine, and placed the beater hoisting wheel on the lower end of the wooden shaft. This improvement was made in the spring of 1872, and was so manufactured by him until 1877, during which time about 800 of the improved beater presses were built, making a total of about 1300 of the Ertel beater presses. (1, p. 20)

The "Economy" press was invented and patented by Mr. Ertel in 1876. This was a single acting machine. Later on this inventor built Ertel's "Farmer's Friend" and Ertel's "Clipper" presses, both being double acting. He continued to manufacture the last named two from 1882 to 1885, when he invented the "Victor" baling press. Mr. Ertel states that he has "taken out about twenty-five patents on hay presses," and goes on to say that "in former years the bales were large, cumbersome things, and tied with large wooden hoops. But very few presses were used then for the reason that flatboats were about the only means of transportation, and markets were very scarce." (1, p. 20)

James Kemp, of Kempton, Illinois, is reported to have said:- "It is about eight years since I made a study of hay presses. My first hay press was a box 16 feet long, with screws on either side, fitting in behind the plunger as the latter traversed the rods of screws, making a bale at each pass of the plunger. It was operated with a separate horse power. Not satisfied with this I next made a double baler with eccentric power; that led to another, a 4-baler, which

was quite a success, but it cost too much to make it. I next made a half circle, or reversible press; it did good work, but was too hard to stake in its place, and too hard for the horses to be turning so much. Then I struck the single cam, full circle, which was good, but it led me to the idea of the double cam, which ***** I have since improved, and I find it to be the most practicable press of any. It now works automatically; presses either damp or dry hay, and it does not require that the plunger be pulled back in filling the press, that being done by the horses." (1, p. 20)

The author of the foregoing extracts states in substance that hay presses have been invented and made West of the Rocky Mountains nearly as long as on the East side of them. "One of the oldest concerns is located at San Leandro, California. It was founded by Jacob Price. ***** In 1863 Mr. Price invented an upright press, which has since been known as the 'Price' and also as the 'Petaluma.' This machine had the machinery for operating the follower placed on the sides of the press instead of in the bottom, thus saving three or four feet in its height, and in the depth of the chamber. Its capacity was from fifteen to twenty tons per day. ***** These old-fashioned presses are called 'muzzle-loaders' and also 'sweat boxes' on account of the tramping process. ***** The 'beater press' which followed, relieved the tramping, but it was higher and more awkward than the simple upright. The beater consisted of a large block in the extended upper end which packed each successive forkful by falling on it after the manner of a pile driver. In 1882 Mr. Price brought out the 'Junior Monarch' an upright portable of great capacity, having a record of twenty tons per day through the season, but the culmination of his work was the 'Hurricane' a portable, horizontal, top-feed, double ender, capable of baling forty tons per day. The power is applied at the center, and presses a bale at each end." (1, p. 22)

The "Globe" press introduced by the Vandiver Corn Planter Company, of Quincy, Illinois, is said to be "a sort of evolution from the 'Favorite' or 'New Favorite,' formerly manufactured by W. J. H. Kappe, of Belleville, Illinois." This is a horizontal, portable press, having, it is claimed, the only "automatic returning beater." Another feature of this press is a feed hole "five inches wider than in others making the same sized bale. It has the largest bale chamber for tying bales, having a clear open tying space of six feet. The contracting device on this press differs from all others, is governed by simple tension rods and does away with the use of springs and other similar devices used for the purpose." (1, p. 22)

"The double acting and continuous" press built by Fairbanks, Morse & Company, of Chicago, known as the 'Eclipse' is described as being "provided with an automatic folder, by which the charges are folded down as they enter the baling chamber. The power is applied in a manner peculiar to this machine, and is an adaptation of the ball and socket principle." (1, p. 22)

A hay baler designed by A. J. Weldon, of Quincy, California, is described in (2, p. 4) as follows:- "This is the most unique press in the history of the West. It is entirely hand made. The compression power was furnished by a horse or mule attached to long sweep; sometimes two horses were used. Early in the year 1868, Mr. A. J. Weldon, who resided on his farm two miles East of Quincy, Plumas County, California, began preparations to build a hay press. He had served an apprenticeship in a shipyard in New York, and this experience enabled him to select suitable material and to work skilfully with tools. Weeks were spent by Mr. Weldon and his son, John, a boy in his teens, searching the hills

for an oak tree with size, length, straightness, and freedom from decay, knots, windchecks, and other imperfections so that the thread of the screw would withstand the enormous pressure to be placed upon it. Otherwise all work would be wasted. The designing of this press was done entirely by Mr. Weldon, as was the selecting of the material. It was very difficult to obtain the proper tools. After the log had been hauled to the farm, Sam Dorithy, a carpenter, was engaged to assist in the hewing to reduce it to the form of a perfect cylinder, the same size for its whole length. Then came the very difficult work of cutting the large thread. This work was done by Mr. Weldon, as it required great skill and judgment, and many days were spent in its completion. In the manufacturing of the press Mr. Weldon had as assistants, Mr. Dorithy and a Mr. Dahlberg, a carpenter, who was passing through that section of California. He worked but a few days, dying shortly afterwards. Nothing was known of the man and none of his people were located. The press proved to be a great success, and with it hay was baled for many years and sent to the mines at Virginia City, Nevada. The bales were packed by mule trains, two bales, ranging from 100 to 165 pounds each, being the load for each animal to carry, the larger mules being loaded with the heavier bales. About the year 1877 the press was sold to George Pennman, who removed it to his farm near Spring Garden, Plumas County. Later it changed hands and was removed to the Mohawk Valley and used there until quite recently." (It should be remembered that the foregoing account was published in 1931.)

Various ideas have been incorporated in the building of hay balers or presses, some of which combined one or more other machines or devices with the hay baler. The United States Patent Office records show that a patent was issued for one of these combined outfits to R. B. and P. Wright on June 18, 1878, for what is called in the Patent Office a hay rake and baling press. A so-called combined hay loader and press was patented by J. A. Shull on December 2, 1879. A patent for another combination baler was issued to Dan Nofzinger, of Leslie, Arkansas, under date of August 6, 1907. This outfit is described as a combined hay gatherer and press.

A writer on the subject of agricultural machinery states that "hay presses may be divided into two classes according to the power used; horse presses which may be one- or two-horse, and the power presses which have power in the form of a gas engine mounted on the frame, or the power supplied from other sources by means of a belt. When horse power is used, no matter whether it be the one- or two-horse type of press, the horses are hitched to a long lever pole called a sweep, and are required to travel in a circle to operate the compressing mechanism. Some balers have long pitmans and operate by pushing the hay into a box. These are called push plunger presses. Other accomplish the same results by pulling, and are called pull plunger presses. ***** Some horse balers may have two strokes of the compressing mechanism to one complete round of the team, while others may have as many as three. The more strokes to the round, the more rapid the baling process will be. Many of these small horse-power presses are fed by hand, the hay being pressed down into the compressing chamber by hand power. Others have an arrangement where the power is supplied by the horses, and have a special arm and feeder head to press the hay down into the box." (3, p. 261)

"The power presses are divided into those which have the power mounted on the frame in the form of a gas engine to furnish the power, and those operated by power not on the frame, such a tractor. An average 6-horsepower engine will do good work in operating a hay baler. ***** All power presses compress the hay

by the use of a pitman and plunger head. The power from the engine to the press is usually transmitted by a belt. All power presses are provided with self-feeding devices. These are operated mechanically, and are so timed that when the plunger is retarded, the feeder is forcing the hay down into the baling chamber. As the plunger comes back, the feeder is raised up out of the way and remains up long enough for a fresh supply of hay to be pitched into the hopper. The speed of the engine and the gearing will determine the number of strokes per minute." (3, p. 261 - 262)

"Many presses are now equipped with a special block-setting device, so that it is not necessary for the operator to risk his fingers or his hand in placing the block. ***** The block is placed in a special container and when it is desired that a new block be set, this container is brought forward by a lever, and the feeding device, on its downward stroke, strikes the block on top, shoving it automatically into place. Other presses may have a special retainer which is tripped by pressing a button, thus setting the block automatically. ***** The size of the press is given according to the size of bale made. The more common sizes are: 14 by 18 inches, 16 by 18 inches, and 18 by 22 inches. The average length of the bale is around 36 inches. ***** The density of the bales is regulated by closing the outlet to such an extent that it will be harder for the compressed hay to be forced out. Naturally the greater the force required to move the hay out of the baling chamber, the greater the density will be, and the more pounds per cubic foot." (3, p. 262 - 263)

"The use of hay and straw baling presses on farms is a comparatively recent development. While machines for this purpose have been employed to some extent for more than half a century, it was not until a later period - some fifteen or twenty years ago" (about 1880 or 1885) "that they became available for the use of farmers generally. The hay crop in earlier times was of no other value than to supply the needs of the farmer, or of the contiguous community, as it could not be prepared for long distance shipment. There were in some localities local presses, which created a market for the surplus hay of a considerable area surrounding them, but the introduction of the mounted hay-baling machine has given a definite value to the hay crop, and the straw of the small grains which they had not previously possessed. While the custom of baling hay and straw is far from being universal on the part of the farmers, it so far obtains that it might be said that a new industry has been created, and the baling press traveling from one farm to another is nearly as common a sight in some localities as the portable threshing machine or power corn sheller. A crude form of press was manufactured and placed upon the market in 1853, which proved awkward in operation and lacking in efficiency. Succeeding this, in 1872, a form of continuous press was invented, which has since come into quite general use. The demand for greater baling capacity than was possible with horse power led to the application of steam power to these machines. A later improvement is a self-tying device. An improved two-horse baling press has a capacity of from 10 to 15 tons a day." (4, p. 363 - 364)

Beginning about 1930 power pick-up balers were being introduced. With such equipment it was possible to pick up and bale hay or straw from the windrow while the baler was being drawn over the field. This development was doubtless influenced by the increasing use of grain combines from which it was a problem to salvage the chaff and straw. The idea of saving the roughage by baling direct from the combine was first considered but did not materialize.

Hence was devised the field pick-up baler, with which it is possible to effectively salvage and bale the straw and chaff left by the combine in the windrow. Such a use, of course, is more or less incidental to the more important function of haying, the operations of which are carried on in a similar manner.

About 1930 a "tractor-drawn and tractor-powered baler with a pick-up attachment similar to that used with grain combines" was designed by R. D. MacDonald, connected with the Ann Arbor Machine Company, and patented by him in 1937.

In describing this outfit it is said that "The machine consists of a standard Ann Arbor baler mechanism, re-designed; frame construction mounted on two 42" diameter wheels having a 12" and 6" face; a power take-off drive transmitted through a gear case in which the cross shaft supports the fly-wheel and drive pinion; the gear case being of Timken roller bearing design is mounted on fiber shock-absorbing shims; a self-feeder which governs a positive and evenly distributed charge of hay or straw fed into the baler; and a pick-up adapted from combine use whose effectiveness has been thoroughly demonstrated for a number of seasons. This tractor-drawn and operated outfit is intended to be drawn through the field where a crop of hay has been windrowed and dried out sufficiently for baling, or through a grain field after the grain has been combined and the straw has been dumped in a windrow instead of scattered by a straw spreader. In the event that the intake of hay or straw should be beyond the capacity of the baler to handle the material, the driver can move a tilting lever which raises the pick-up and automatically disengages the pick-up drive clutch. By shifting the tractor into neutral, the take-off shaft would continue in operation, allowing the baler to handle the slug. Variations in the amount of hay or straw per foot of travel in relation to the speed of baling would be met by employing the various tractor speeds, high, intermediate or low, as the pick-up is ground driven. Thus in baling straw of minimum volume, the tractor could be operated in high gear, while in handling a windrow of heavy hay, or of more mass, formed by laying two successive swaths together, the tractor could be operated in low gear. With this outfit, one man on the tractor, plus one or two on the baler running boards to tie the bales, could handle the entire baling job without assistance. The bales can push themselves into a wagon or trailer hitched on the rear of the machine, and dumped on one or each end of the field for hauling. The need for a large baling crew and for numerous teams of horses and bull rakes are eliminated. The necessary operations in handling the crop are spread out so as to use labor and power to the best advantage." (5, p. 26)

This outfit is represented as being of special value in the baling of alfalfa, as it "reduces the handling of the crop, thus lessening the amount of leaves shaken off in other operations." An other very important use for this baler is in saving the straw from grain crops that have been windrowed or straight combined. "By using a plain straw dump on the combine the material would be left fairly well bunched. Side raking would put it into more compact windrows if necessary. Then after any spell of dry weather the combine baler could be sent into the field, and the straw reclaimed for farm use or for shipment to a strawboard mill" (5, p. 26-27)

"A method of handling that has been tried by some consists of baling the hay as it is picked up from the windrow. A machine used for this purpose, known as the windrow baler, consists essentially of a stationary baler with an attachment for picking up the windrow and automatically feeding the hay into

the baler. The machine, which is drawn by a tractor, is designed so that the baler is operated through the power take-off shaft from the tractor engine. From three to four men are needed to run the outfit. Besides the tractor operator, one man is required to handle the blocks and the wires, and a third man is needed for tying the wires. An automatic feeding device controls the movement of hay into the baler. When the hay is heavy, however, it is necessary that some attention be given the feeding operation. If the help is available, a fourth man can be used to good advantage."

"On most farms the bales are dropped on the ground by the baler and are picked up later and loaded on wagons. Some operators draw a low wagon or trailer with a flat rack behind the baler. The bales are put in place on the rack as they come from machine and thus considerable handling and heavy work is eliminated. Hay that is baled from the windrow is handled very little after it is dry. As a result the loss of leaves and breakage of stems is considerably less than is the case with unbaled hay. ***** The average tractor travels in low or intermediate speed when drawing the windrow baler at work. Several observations were made of the rate at which the outfit travelled from one end of the windrow to the other. The average was found to be slightly less than 2 miles per hour. This included the necessary occasional stops. Bales were made at the rate of 70 per hour. The average weight per bale was 76.5 pounds. This makes a capacity of 2-2/3rds tons per hour. ***** The bales were 14 inches wide, 18 inches high, and varied somewhat in length. The average length of 16 bales that were selected at random was 43 inches; the shortest was 39 inches and the longest 50 inches." (6, p. 26)

Under date of July 25, 1933, a United States patent No. 1,919,897, was issued to Wallace F. MacGregor and Martin A. Richardson for what the patent calls baling machinery. The following brief description of this apparatus is taken from the patent itself:- "Our invention relates to baling machinery of the character adapted to be drawn through the fields by a tractor for picking up cut alfalfa and other crops, and elevating the same to a conveyor or otherwise, to be delivered to a complementary baler, our object being to provide a flexibly mounted pick-up which will be self-adjusting to follow ground inequalities encountered in field operations, and the conveying mechanisms thereof preferably actuated from a groundwheel, or otherwise."

Under date of July 28, 1936, improvements were made to the above described equipment in patent 2,048,940. The improvement included a cutting device mounted ahead of the pick-up unit, with the idea of cutting and baling standing stubble from which the crop had already been harvested. This would refer especially to small grain crops, which in combining or heading had been cut high, leaving considerable straw standing; corn stalks from which the ears had been picked, or any other standing crop from which the moisture content had been reduced sufficiently to be in condition for baling as it is being cut and gathered in the field.

Both of the above mentioned MacGregor patents were assigned to the J. I. Case Company, of Racine, Wisconsin, which later built pick-up balers operated either by power take-off of tractor, or by mounted engine on the baler.

Another of the comparatively new machines designed to speed up the hay harvest is a John Deere windrow pick-up hay press, which makes use of a double eccentric-gear mechanism for operating the plunger and transmission. "By

utilizing a construction long standard with the Company for stationary presses, the Company obtains a baling action in which the compressing force is stepped up on the power stroke, and a quick return is obtained on the recoil. For 70 per cent of the cycle the feeder head is in vertical position out of the way of the feeder. The pick-up is of sturdy aspect, mounted on caster wheels in line with the cylinder so that they act as gauge wheels for the height of the pick-up fingers. The pick-up drive comes from the left hand ground wheel opposite the pick-up, and with turns always made to the right constant speed is obtained on the pick-up cylinder. Tight-deck construction is followed on the pick-up to avoid loss of tender leaves, and the hay is delivered at the top to a wide cross conveyor that carries it to the feeder opening. This cross conveyor is driven from the main transmission, and can be started, stopped or reversed by a lever which can be kicked over with the foot, or operated by hand. Power to operate the field baler, other than the pick-up drive, comes from a separate 20 H.P. engine, mounted ahead of the press drive gears, and delivering the power to them by belt. With this separate engine drive the baling action continues whether or not the tractor is going ahead. It thus is possible to stop the tractor in heavy going and permit the baler engine to clear any excessive charge." (7, p. 26)

"As bales are forced out of the press the blocks drop into a block catcher handy to the tyer, in addition to which there is a block carrier on top the bale case. Footboards are attached to both sides of the press so that the tyer can work from either side. Another footboard is attached behind the cross conveyor so that a man can work there in very heavy hay. A wire carrier of metal tubing provides a convenient means of carrying the bales Ties." Stress is laid by the manufacturer upon "the great capacity of this windrow baler" as well as upon "the strength of the overall construction, and the work of the eccentric gears." (7, p. 26)

It is said of the Innes hay maker that it "applies a new method of hay harvesting. ***** The hay is first cut, then handled and then cured. The handling precedes the curing. The curing is done in a 'cock with a hole in it.' What the machine does is to weave a thatched bale with a horizontal hole through the center, and a string around the outside. The stems are spiraled into the feed chamber in thatched form, not folded and tucked into a compressed flake or mat, so that so spiraled the air can get into any one part of the Innes bale as easily as into any other part. The hole running through the inside of the bale seems to be the crucial element in the process of curing in a bale rather than in a windrow or swath." (8, p. 23)

"To save work in baling, the windrow pick-up baler was developed. In principle it is a combination of an ordinary pick-up device for taking the cured hay from the windrow and a conventional hay baler with a conveyor to conduct the hay to the baling chamber. On most pick-up balers--which form rectangular bales--is a slicer device, which consists of a knife on the plunger head and a stationary shear plate mounted at the edge of the feeder opening. As the plunger moves on its compression stroke, the hay projecting from the feed opening is sheared off so that each charge becomes a slice.

"Available in this type of baler are the three-man wire baler, the two-man wire baler, one-man wire baler, and one-man twine baler.

"On the three-man type, one man rides on one side of the machine and pushes the tie wire through to the man riding on the other side, who ties the wire; the third man drives the tractor.

"On the two-man wire baler, one man does the tying and the other drives the tractor. On the one-man baler, either wire or twine, baling and tying are automatic, and the man drives the tractor. The heavy twine sometimes used in this type baler has about three times the strength of ordinary binder twine. The bale is usually about 14 by 18 inches in section by about 36 inches long and weighs around 60 pounds. In bales tied with wire, the common sizes available are 14 by 18, 16 by 18, and 17 by 22 inches through and about 40 inches long; the weights are about the same as those given for stationary balers. Two ties are generally used, except in the larger sizes, such as 17 by 22, when three are commonly used.

"One type makes a round bale. Its pick-up feeds the hay into a series of belts, so that the hay is rolled up like a carpet into a bundle 36 inches long and 14 to 22 inches thick. The machine can be regulated to bale tight or loose bales, so that their weight ranges from 40 to 100 pounds, depending on the density and diameter. When the desired thickness is attained, a tying mechanism causes a strand of binder twine to wrap around the bale near one end and then spiral around the bale to the other end, where it is cut. The bale is then discharged, and the process is repeated. This is a one-man baler.

"As the hay is baled by the pick-up baler, the bales may be dumped in the field and picked up with a hook by hand or by a special bale pick-up, or pushed onto a trailing truck on an extension of the baling chamber." (9, pp. 169-170)

(Written in 1946) "It is only nine years ago that the twine baler had its inception. The first of these automatic machines was conceived and built by Edwin B. Nolt of Lancaster County, near New Holland, Pennsylvania. However, it was not until 1940 that the first completely automatic twine baler was put on the market for sale in any quantity. Credit for producing these first machines goes to the New Holland Machine Co., of New Holland, Pa. In 1944 the International Harvester Company produced the first of its version of this type of machine for sale." (10, p. 501)

(In 1946) "Until recently hay buyers have been accustomed to wire-tied bales. It would be shortsighted to assume that wire-tied bales will always be the most commonly seen on the market, as other materials more suitable might develop, or some existing material might be adapted to this purpose and become popular at any time. The reason wire is popular now is that it is economical, easy to obtain, strong, uniform in strength and form, is durable, is not attacked by insects or rodents, and can be put in a compact form for transporting and storage.

"It was with this in mind that the automatic wire-tying balers have been and are being developed.

"Anyone who has worked on the problem of developing an automatic hay baler for wire, I am sure, is impressed by the large number of patents issued in comparison with the number of machines manufactured. These patents started to issue about 1892. At the present time (1946) there are only two machines on the

market which are fully automatic. No doubt, development work is progressing on others." (11, p. 503)

The 1948-49 Tractor Field Book published by the Farm Implement News shows 4 manufacturers of self-tying twine balers, and 3 manufacturers of self-tying wire balers.

Field forage harvesters

"Often, with a field grass chopper, the green crop is cut and chopped for silage as it stands in the field. This machine is operated by the tractor power take-off and is a combination of a mower (which is provided with a reel to whisk the material back onto a conveyor) and a chopping box (which is fed by this conveyor), from which the chopped material is blown into a trailing truck or wagon. The material, transported to a silo, is blown into it by means of a power-driven combination screw conveyor and blower. When it is placed directly into the silo, the chopped grass has a rather high moisture content, so that some sort of preservative sometimes is added. If the material is allowed to wilt in the field and lose 10 to 20 percent of its moisture before ensiling, however, no preservative is needed." (9, p. 168)

"Sometimes it is expedient to chop cured hay and place it in the mow. This may be done by a field hay chopper, which differs from the green-crop chopper in that a pick-up cylinder replaces the cutter bar. The dried hay is thereby picked up and is caused to pass into the chopping box; from there it is delivered by means of a blower and spout into the trailing truck. It is then transported to a blower and blown into the mow. Sometimes the whole hay when cured is taken from the windrow, chopped by a stationary hay chopper, and blown into the mow." (9, p. 168)

"The term 'forage crop harvesting' is intended to include grass silage, dry hay, straw behind the combine, and it is to be hoped that the field harvesting of corn for ensilage may also be included.

(In 1940) "The Fox River Tractor Co. has completed the fifth year of commercial production of their large machine, and during the past season the following companies had experimental machines in the field: Allis-Chalmers Mfg. Co., Eagle Mfg. Co., Gehl Bros. Mfg. Co., John Deere Plow Co., International Harvester Co., and Massey-Harris Co. There may have been others which have not come to our attention. Interest in this method of harvesting grass silage and hay is evidenced by the fact that there have been several homemade machines built during the last two or three years; it is reported that one mechanically minded farmer in Iowa built and sold some five machines in the early part of 1940." (12, pp. 11 & 12)

"It is perhaps impossible to say just when self-unloading wagons for chopped forage were first used, and it probably isn't important. There is a patent dated 1901 for a self-unloading freight car, another in 1903 for a grain wagon, and one in 1915 for a bundle wagon, besides many other specialized applications which have been patented. I believe it is quite safe to say that self-unloading forage wagons have become practical only as a result of field chopping of forages. It is to be expected that increased use of field-chopped forage and bedding should bring with it an increased demand for unloading devices. ***** I have arbitrarily set up four classes of self-unloading equipment: (1) chain-and-slat conveyors,

(2) false endgates, (3) canvas bottom, (4) tilting beds. These classes occasionally overlap but generally retain their separate identities pretty well. Proponents of each will argue vigorously for their own design and generally seem to hold all others in pretty low esteem." (13, p. 188)

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Fig. 1. "Old style" portable hand press.

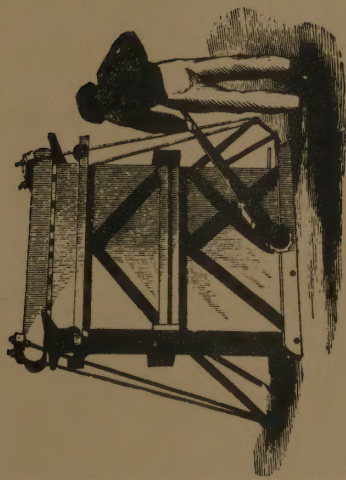
Fig. 2. "Old style" portable horse hay press.

Fig. 3. Dederick's "New Style Press."

Fig. 4. Modern hay press powered with 6 horsepower gasoline engine.
The approximate capacity of this press is 20 to 24 tons in 10 hours.

Fig. 5. Pick-up baler of large capacity operated by 2 men. This machine picks up hay or straw from the windrow and bales it similar to an ordinary hay press.

- Fig. 6. Pick-up baler which is operated by the man that drives the tractor. This baler uses twine, is self-tying, and has its own engine for operating the baling mechanism.
- Fig. 7. Tractor-mounted bale loader which picks up bales from the ground and elevates them to a trailed wagon or rack. Rectangular bales can be picked up as well as the round bales shown.
- Fig. 8. Field forage harvester picking up hay from the windrow, chopping it, and blowing it into the trailing wagon.
- Fig. 9. Self-unloading wagon for chopped hay. A small gasoline engine, through a reduction gear, operates an endless chain and slat conveyor which moves the chopped hay to the rear of the wagon where it drops into the feeder of the blower.



OLD STYLE PORTABLE HAND PRESS.

1



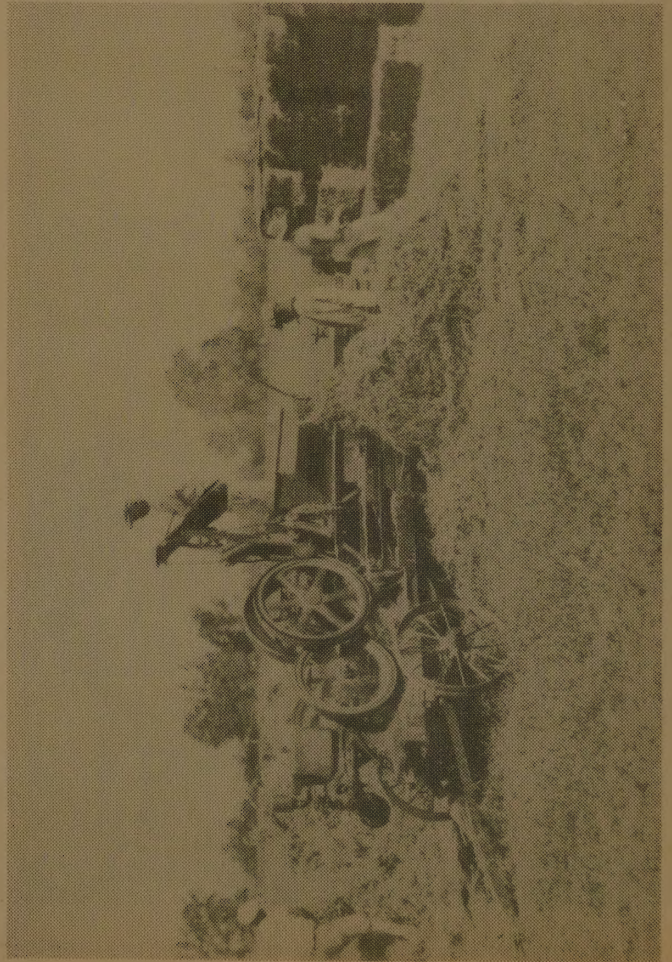
OLD STYLE PORTABLE HORSE HAY PRESS.

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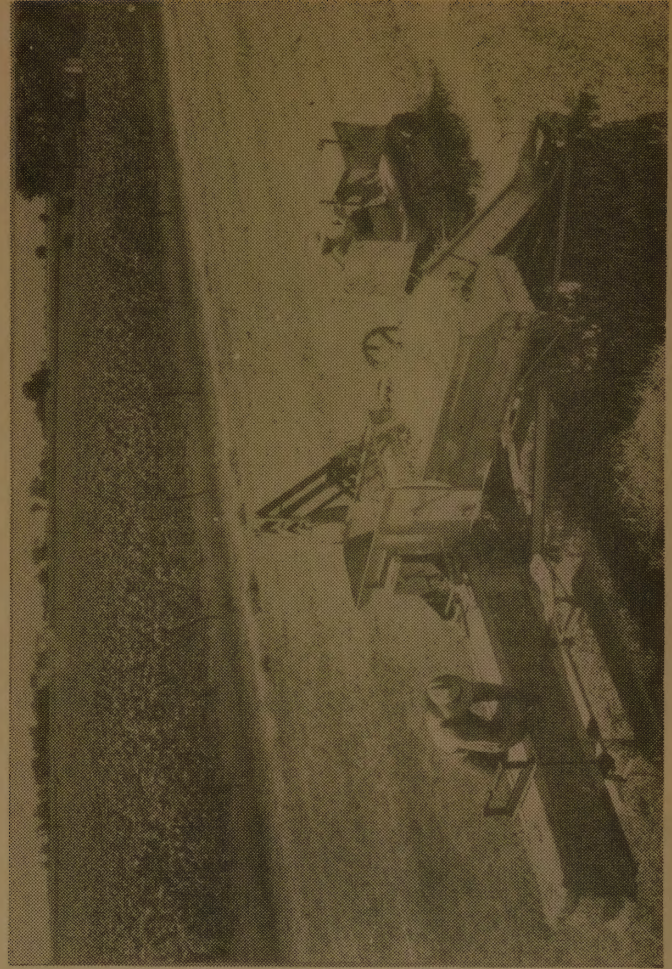


DEDEHICK'S NEW STYLE PRESS

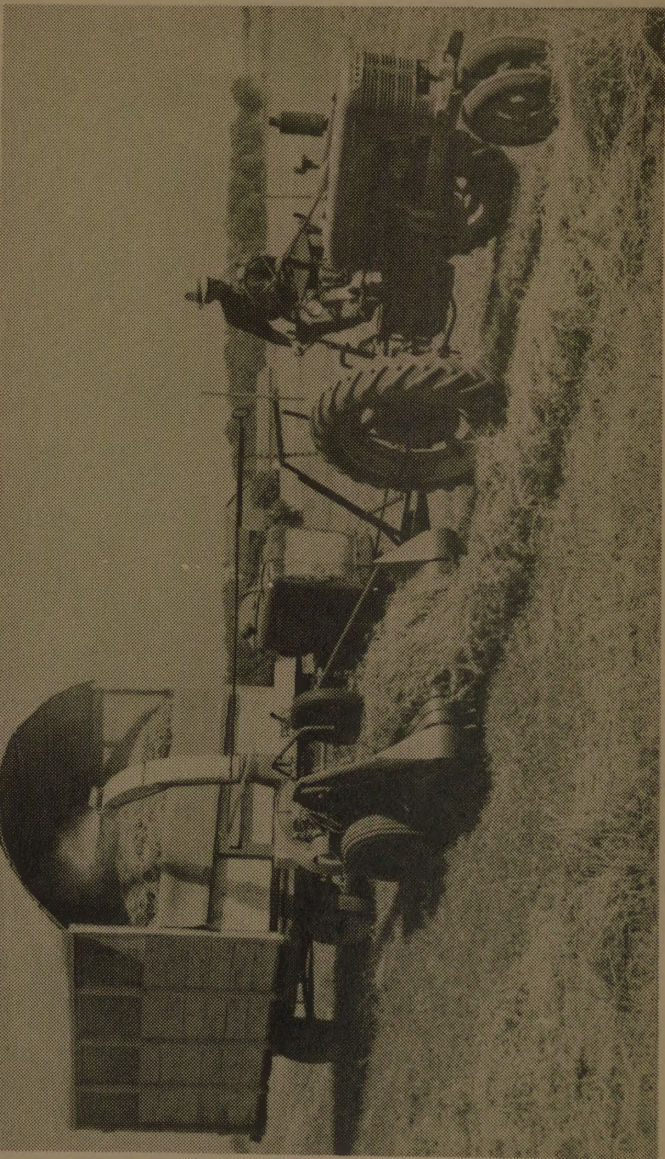
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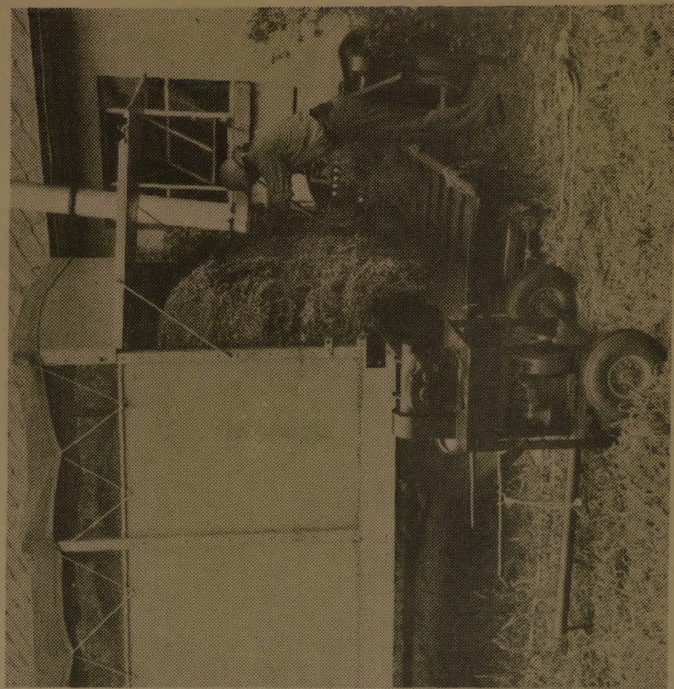
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